

# Water governance challenges in rural South Africa: exploring institutional coordination in drought management

Eugine Makaya<sup>a</sup>, Melanie Rohse<sup>b</sup>, Rosie Day<sup>c</sup>, Coleen Vogel<sup>d</sup>,  
Lyla Mehta<sup>e</sup>, Lindsey McEwen<sup>f</sup>, Sally Rangelcroft<sup>g</sup>  
and Anne F. Van Loon<sup>h</sup>

<sup>a</sup>*Department of Civil and Water Engineering, National University of Science and Technology, Cnr Cecil and Gwanda Road, Bulawayo, Zimbabwe*

<sup>b</sup>*Global Sustainability Institute, Anglia Ruskin University, East Road, Cambridge, Cambridgeshire CB1 1PT, UK*

<sup>c</sup>*School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham B15 2TT, UK*

<sup>d</sup>*Global Change Institute, University of the Witwatersrand, 1 Jan Smuts Ave, Johannesburg 2000, South Africa*

<sup>e</sup>*Research Department, Institute of Development Studies, Brighton BN1 9RE, UK*

<sup>f</sup>*Centre for Water, Communities and Resilience, University of the West of England, Bristol BS16 1QY, UK*

<sup>g</sup>*School of Geography, Earth and Environmental Sciences, University of Plymouth, Drake Circus, Plymouth, Devon PL4 8AA, UK*

<sup>h</sup>*Corresponding author. Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam, De Boelelaan 1087, 1081 HV Amsterdam, The Netherlands. E-mail: anne.van.loon@vu.nl*

---

## Abstract

Droughts have severe direct impacts on the livelihoods of rural populations. Thus, the management of water for communal agriculture and water supply should be well coordinated to enhance drought resilience. Notwithstanding the interrelations among water management institutions in South Africa, there are complexities in the way these institutions work together, both in preparation for, and during drought times. In this article, we examine the governance of water resources in South Africa with a view to understanding institutional coordination in drought management at different operational scales. Using a qualitative approach, the roles and relationships between water actors at the local and regional level were analyzed for their adequacy in building local level drought resilience in a village in the Limpopo province, South Africa. Key informant interviews conducted revealed operational drought management challenges that emanate from communication barriers, coordination inconsistencies, and undefined, unclear actor roles and responsibilities during disasters. The top-down approach

---

This is an Open Access article distributed under the terms of the Creative Commons Attribution Licence (CC BY 4.0), which permits copying, adaptation and redistribution, provided the original work is properly cited (<http://creativecommons.org/licenses/by/4.0/>).

doi: 10.2166/wp.2020.234

© 2020 The Authors

to disaster management, while of some value, currently constrains the effectiveness of the local-level institutions implementing local drought risk reduction efforts. Achieving more successful water and drought governance endeavors could be enhanced by greater and wider engagement with community-based actors and water management institutions.

*Keywords:* Disaster management; Drought management; Drought risk reduction; Institutional coordination; South Africa; Water governance

---

## Introduction

Southern Africa has been experiencing, a series of recurrent droughts over the past few decades (Usman & Reason, 2004; Masih *et al.*, 2014), resulting in many rural communities suffering from the impacts of these droughts. Droughts are costly hazards, with severe negative socio-economic impacts. Drought can be defined as a sustained period of deficit in water availability (e.g. precipitation, soil moisture, streamflow, groundwater, etc.) compared to the norm (Wilhite & Glantz, 1985; Tallaksen & Van Lanen, 2004). Pereira *et al.* (2009) define drought as a temporal imbalance of water availability resulting from a persistent lower than average precipitation of uncertain frequency, duration, and unpredictable severity. Four common types of drought are described as (i) meteorological drought (precipitation deficiency), (ii) agricultural drought (soil water deficiency), (iii) hydrological drought (reduced streamflow and inflows from reservoirs); and (iv) socio-economic drought (social, economic, and environmental impacts) (Tallaksen & Van Lanen, 2004). More recently, the human dimensions of drought have gained more attention with anthropogenic drought defined as having socio-political and economic causes and impacts (AghaKouchak *et al.*, 2015; Van Loon *et al.*, 2016). Alternatively, droughts can be described in terms of their timescales as short-term (4 months or less), medium-term (4–12 months), or as long-term (more than 12 months) (Botai *et al.*, 2016). Multi-year droughts are a common phenomenon in South Africa (Smith, 1993; Tyson & Whyte, 2000; Rouault & Richard, 2005), and it is expected that climate change and a range of socio-economic factors will amplify existing stresses on water availability for agriculture, affecting public health and food and water security (IPCC, 2013, 2014).

The governance dimensions of water access are fundamental to effective risk reduction at the time of a drought. The access to water during droughts is determined by the prevalent governance systems. Few detailed assessments of drought and drought responses that encapsulate both the biophysical and socio-economic and historical dimensions of drought have been undertaken for southern Africa (Davies, 2000; Vogel *et al.*, 2010; Vogel & Olivier, 2019), particularly in terms of assessing the administrative role of institutional and other governance systems (Baudoin *et al.*, 2017). By interrogating past response measures to drought at various governance scales (e.g., local and regional), some of the strengths, weaknesses, and lessons learned in response to drought can be derived. Despite the different interpretations of a ‘drought’, recent efforts in disaster management and disaster risk reduction have called for a radical shift in paradigm. This has included moving from a reactive approach to disasters such as droughts (e.g. via food aid) to a more proactive approach (e.g. by making water governance systems more effective, focusing on current and future risk reduction, and ensuring that water infrastructure is regularly maintained) (Vogel *et al.*, 2010). One example of a more proactive approach to drought management in South Africa is the Agricultural Drought Management Plan (ADMP) based on the Disaster Management

Act 2002 (Act 57 of 2002). This plan has four key performance areas, namely integrated institutional capacity, disaster risk assessment, disaster risk reduction, and response and recovery, and is seen to enhance proactive drought risk management, information management and communication, education, training, public awareness and research, as well as funding arrangements (Van Zyl, 2016). A significant gap, already noted by Hornby et al. (2016), appears to be coordination of the widespread but localized efforts by the government, civil society, and private sector, particularly in identifying and responding to the areas and people most in need.

In this paper, we will examine drought management with reference to institutional preparedness and responses to drought in South Africa using a case study of a village in Limpopo province. The paper provides a background on water management in South Africa; describes the methodological approach used; explains how droughts are managed; and evaluates institutional responses to droughts in South Africa with barriers and opportunities identified by drawing on qualitative data. The key arguments of the paper are focused on institutional coordination (both horizontally and vertically) in drought management.

## Background

### *Drought management legislation and institutions in South Africa*

The South African water management institutions are shown in Figure 1. DWS is responsible for bulk water supply, monitoring and control (rights and licensing), while the Water Services Institutions (WSI) are responsible for end-user water supply (installations, metering, and billing). South African water governance is driven mainly by the constitution, and water-related legislation, such as the National Water

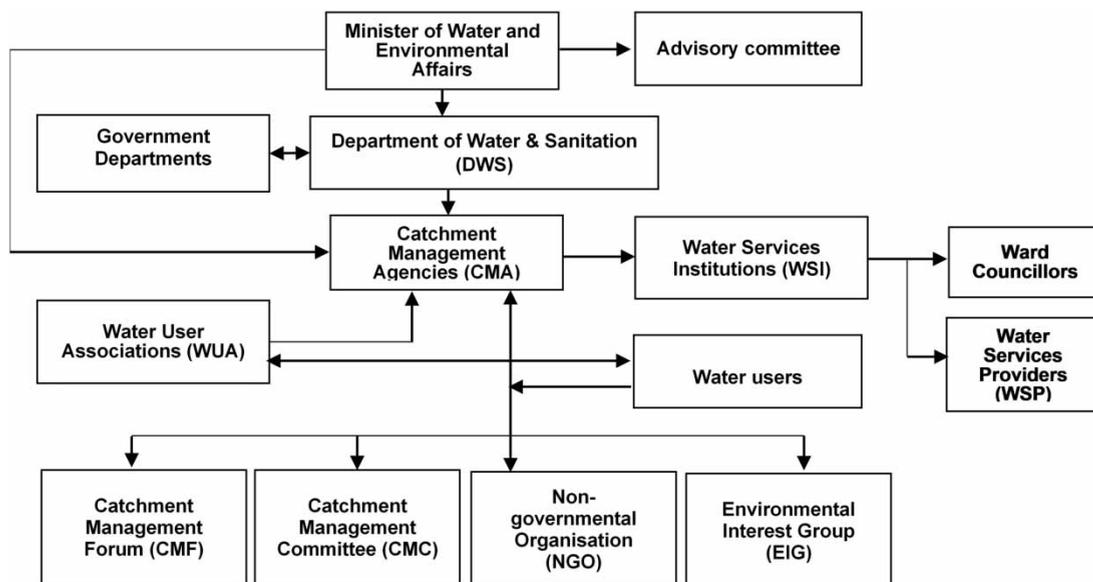


Fig. 1. Water Management Institutions in South Africa (adapted from Kapfudzaruwa & Sowman (2009)).

Act (NWA; Act 36 of 1998) and Water Services Act (WSA; Act 108 of 1997), administered by the Department of Water and Sanitation (DWS) at its core (RSA, 1997, 1998). The DWS is responsible for managing dams and maintaining infrastructure such as boreholes and storage reservoirs, for both urban and rural communities. The WSA governs domestic water supply services and delegates responsibilities for such services to Water Services Authorities, such as municipalities, water utilities, and private firms. According to the WSA, the local municipality is responsible for taking care of the distribution network and the use of water.

The NWA recognized the need for suitable water management institutions to be able to achieve robust water management. The Act defines water management institutions such as Catchment Management Agencies (CMA) and Water Users' Associations (WUAs) (Figure 1). The aim of the NWA was to establish a CMA in all the 19 Water Management Areas (areas of operation of CMA) of South Africa. The purpose of establishing a CMA was to delegate water resource management to the regional or catchment level and to involve local communities, within the framework of the South Africa National Water Resource Strategy (Mwenge-Kahinda et al., 2016). The CMA manages water resources within its defined water management area according to its catchment management strategy. Within the CMA are Catchment Management Committees, and Catchment Management Forums who promote community participation within a water management area. WUA is a grouping of water users who wish to work together because of a common interest. WUAs enable individual water users, who wish to undertake water-related activities for their own benefit, to form cooperative associations (Swatuk, 2010).

The NWA identifies water rights as pertaining to basic human and ecological needs for water. The complete system of governance for water in South Africa is a three-dimensional system of elements, including (i) principles and mandate, policies and legislation, regulatory framework, institutional arrangements and practice; (ii) levels from the international, national, regional, local to neighborhood levels; and (iii) responsibilities of government, non-government organizations, and civil society (WRC, 2018). Kapfudzaruwa & Sowman (2009) and Hornby et al. (2016) state that there is a lack of integration between the national government institutions and the non-formal institutional provisions in South Africa.

Faysse (2005) argues that the need for people-oriented management in water resources management provides an opportunity for water management institutions to share ideas with the local community. However, an attempt to engage communities in decision-making has often led to allegations and counter-allegations between DWS and the municipalities on the management of water resources at the community level (Kapfudzaruwa & Sowman, 2009). The DWS narrative claims that municipalities are not planning properly in terms of water supply and are inherently inefficient (Weaver et al., 2017). The counter-narrative is that municipalities claim that they want changes and are keen to re-allocate water for multiple uses, and not only for domestic uses. However, the DWS seems less interested in devolving its mandate to other institutions because it wants water allocation to remain in its own hands (Weaver et al., 2017). The same notion is reiterated by Sithole & Mathonsi (2015) who argue that there is a strong belief within the municipalities that there is a big difference between political promises and concrete service delivery issues, where water service delivery falls within the municipalities' mandate.

The South Africa constitution grants a right of access to sufficient water for domestic uses and not a right to adequate water (i.e. sufficient amounts but not abundant or overflowing) and excluding water for other uses besides domestic uses (Thompson, 2006). This means that water users cannot compel the government to provide them with enough water for their other water needs outside of domestic needs during drought times. In this instance, communal farmers suffer as they should procure water from

private water suppliers during drought times, the cost of which is beyond the means of many. Thus, the national constitution is noble in its intentions but has been less successful in its execution (Hornby *et al.*, 2016).

### *South African drought management*

In South Africa, at the national level, one Act and several policies and strategies are in place to deal with drought conditions. These include the Disaster Management Act (No. 57 of 2002), the National Disaster Risk Management framework of 2005, and the Drought Management Plan of 2005. The government of South Africa has established the National Disaster Management Center (NDMC), which acts under the auspices of the Department of Provincial and Local Government, with the Department of Agriculture chairing the Inter-departmental Working Group on Drought (DMP, 2005). Drought management in South Africa is coordinated at the national government level and executed through government departments or structures at the provincial or local municipality level. For operationalization of the Act, policies and strategies, South African provincial municipalities have their own drought management plans (Luker & Rodina, 2017). In particular, the South Africa Joint Operation Committee (JOC) is the major collaboration platform where all stakeholders in drought management participate. However, such approaches require suitable financial support and human capital, as well as appropriate institutional architecture, if they are to be successfully rolled out. Vogel *et al.* (2010) assert that narrow forms of governance, including inflexible state and regional responses that remain rooted in the histories that initially created reactive drought responses and interventions, can be detrimental to building local drought resilience.

### *Institutional responses to drought in South Africa*

Drought, like any other disaster, should be responded to expeditiously by all responsible national government institutions to ameliorate drought impacts. Institutions such as the South Africa Weather Services usually announce the onset of a drought (based on a series of weather and climate pattern analysis) in the local media and to other government departments such as Department of Agriculture and Rural Development (DARD) and the DWS. DARD houses the Disaster Management Unit that implements the disaster management plan. DARD cascades the information to local agriculture extension officers who alert farmers about impending drought, while DWS monitors and controls dam releases. Despite these governance arrangements the responses to drought contain a strong reactive element (Vogel *et al.*, 2010; Baudoin *et al.*, 2017), limiting the capacity for communities to prepare for drought.

As early as 1923, drought was seen as one of the constraints faced by South African farmers in their agricultural enterprise. Early reports (e.g. the benchmark Union of South Africa, 1923, reported on drought) resulted in an overall assessment that drew attention to the role of the interlinked issues of poor planning and institutional design, and deteriorating soil and vegetation status that heightens drought impacts and vulnerability to drought (Union of South Africa 1923 in Vogel *et al.*, 2010).

The interchange of information on droughts and disasters within the same department (e.g. DARD and DWS) indicates horizontal information flow, and the exchange of information between different functional levels (e.g. communities and provinces) is vertical information flow. The multiple vertical and horizontal flows of information among institutions contribute to creating a very complex system

that is activated, more recently, with the implementation of the Disaster Management Act (DMA). Back and forth reporting processes appear to delay the implementation of any concrete and timely drought response on the ground (Baudoin *et al.*, 2017).

The present study arose from the need to understand the effectiveness of the interrelations between water and drought management institutions and structures, particularly coordination between the local level and/or the district level and the national government level. Critical was to investigate what these arrangements mean for local communities dealing with the harsh reality of drought, using a case study of a village in Vhembe district of Limpopo province, South Africa. Key informants drawn from community- and district-level institutions were interviewed with respect to their roles in water and drought management.

## Case study and methodology

### *Case study location*

Limpopo province was chosen in this case study because of high levels of inter-annual precipitation variability leading to regular droughts, and its vulnerability with regards to food and water security (Vincent *et al.*, 2010; Mwenge-Kahinda *et al.*, 2016). It was also chosen because of the varied water uses (domestic and irrigation) and water sources (springs, boreholes, canals, and rivers) in the catchment. A village in Vhembe district (located in the north-east of Limpopo province), Folovhodwe, was selected mainly due to its experience of recurring drought events, and the communal farming and rain-fed agriculture which are major agricultural practices in the district. Due to high unemployment rates in the Vhembe district, households rely on crop production and livestock for their livelihood (Musetha, 2016). The greater part of the Limpopo River Basin receives less than 500 mm of precipitation per year (FAO, 2004). Two dams are the major source of water for irrigation; these were built in the 1960s and now require maintenance (Rangecroft *et al.*, 2018). Water is diverted from the dams to small community plots and larger commercial farms. The latter also divert water directly from the river running through the village. This river is used for multiple other purposes, such as washing and bathing. The same is the case for the irrigation canals. Groundwater is used for drinking water via a borehole and for cattle via springs, which are known to dry up during drought. The current borehole was installed in 1999 and is 99 m deep. It is connected to a water storage tank where the water is treated before being distributed in a system of water pipes and communal water taps in the village. Due to the imbalance between water supply and demand, the taps situated in different sub-villages of Folovhodwe supply water only on a number of designated days (typically twice a week). Folovhodwe is estimated to have a population of 2,800 people (StatsSA, 2017) and is located on the Nwanedi River (Figure 2), a tributary of the Limpopo River with a catchment area of 897 km<sup>2</sup>.

### *The approach*

The research articulated here aimed to assess how periods of drought are understood, framed and managed both by government officials and by local residents. Management flows and coordination of water by water managers and the community (collectively hereafter referred to as actors) were investigated. At the same time, challenges to such governance arrangements were noted and interrogated.

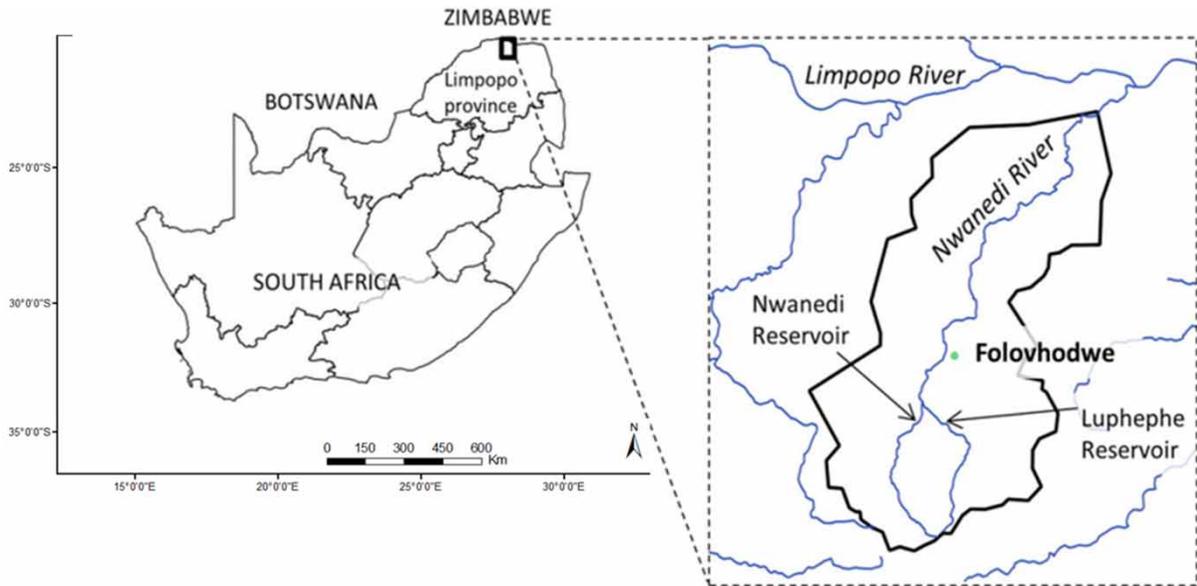


Fig. 2. Map of South Africa showing Limpopo province, Nwanedi Catchment and Folovhodwe Village (adapted from Rangecroft *et al.* (2018)).

A conceptual framework (Figure 3) was used to guide the study toward improved understanding of the nature, strength, and intricacies of the institutions responsible for drought management, with particular emphasis on management of water resources. This study will look at enablers (systems and factors promoting coordination) and barriers (systems and factors impeding coordination) to drought coordination at both the community and district level.

### Methodology

In this study, a qualitative research methodology was used to better understand governance around periods of drought in Limpopo province. We adopted a purposive selection strategy to select key informants, who were interviewed to identify challenges and opportunities, contextual issues and any tensions in drought risk governance. Variables considered in their selection included knowledge and experience of living and working in the study area, and their involvement in water governance at the community and district level. Interviewees were selected in the first field season (March/April 2017) of the CreativeDrought Project<sup>1</sup> from community-level and district-level institutions for interviews conducted between September and October 2017. Interviews were conducted in English, and only the civic group (a group of community leaders) required translation from English to Venda (the local language). Interviews were audio-recorded, transcribed, and analyzed to establish institutional linkages and coordination in drought management. The transcriptions were qualitatively analyzed for emergent themes,

<sup>1</sup> (<https://createdrought.wordpress.com/>, a project which sought to understand past and future drought impacts and management in the area and develop greater drought preparedness through interdisciplinary methods).

Enablers	Barriers
Community Level Enablers	Community Level Barriers
District Level Enablers	District Level Barriers

Fig. 3. Analytical framework of enablers and barriers used in this study.

extracting information on the barriers and enablers to drought management for different actors. In all cases of data collection, consent to be interviewed and audio-recorded was sought from all participants. Participants were selected to represent seven different key stakeholders: Folovhodwe Village Civic Group leadership, Civic Group Committee, senior managers (crop production) in the Department of Agriculture, Agriculture Advisors in Mutale Local Municipality, senior officers in the DWS – Limpopo province, and officers from the Disaster Management Unit in the Ministry of Agriculture (Table 1). District-level institutions (DL) and Community-level institutions (CL) were the two focus scales involved in the study.

In conjunction with the interviews, the study analyzed policies for context and further qualitative information. These included the following documents: The National Water Act of 1998, the Limpopo Draft Drought Intervention and Communication Strategy (2015/16), the Regional Drought Management Strategy for SADC (Ncube & Chisvo, 1999), and the Limpopo Province Disaster Management Plan 2017.

## Findings

### *Droughts in Vhembe district*

Vhembe district of Limpopo province of South Africa is relatively dry, receiving precipitation below 500 mm annually. The district usually experiences extremes in temperature, with summer temperatures exceeding 35 °C. Information about droughts in Vhembe district was gained from the district-level key informants. The district-level respondents described and explained droughts as follows:

*‘Drought is a hazard and becomes a disaster when it affects vulnerable people or communities; and if they [people and communities] don’t have the capacity to cope through their available resources’ (DL2).*

Table 1. Participant details.

Reference	Institution
DL1	Department of Water and Sanitation
DL2	Department of Agriculture – Disaster Management Unit
DL3	Department of Agriculture – Crop protection Unit
DL4	Department of Agriculture – Advisory Services
CL1	Department of Agriculture – Extension Services
CL2	Civic Group Leadership
CL3	Civic Group Committee

*‘Declaration of drought depends on the type of drought. Drought can be declared as Municipal drought, Provincial drought or National drought due to their extremity. The disaster management committee at District, Province or National level is the one that assesses the extent of extremity of that particular natural event’ (DL4).*

A number of major drought events were identified by the interviewees and their level of satisfaction with the drought intervention by the government for each drought period identified was noted (Table 2). The level of satisfaction with the intervention (in terms of speed of reaction by government, services provided, and government subsidies) is summarized in Table 2. There has been a general improvement in the government’s response to drought, especially the 2012 and 2016 droughts according to the assessment of the interviewees. Such improvement is attributed to improved communication and logistic systems of South Africa.

### *Drought management mechanisms*

Disaster management in South Africa is undertaken by a number of departments and institutions representing government, farmers, and civic society (see section Drought management legislation and institutions in South Africa). Thus, decision-making about drought intervention is made through wide consultation, however, the effectiveness of such consultation is contentious.

*‘During a JOC meeting, other stakeholders [from other departments and institutions] are sent to make decisions’ (DL2).*

Despite their representation in the JOC, the contribution of the civic society at the district level to decision-making about drought management is least considered. This is mainly because most decisions about drought are done at the central government level and information is just passed on to the communities.

At the community level, it has been found that farmers apply different coping and adaptation strategies to increase production during drought periods, including (a) adjust fertilizer inputs; (b) practice crop diversification; (c) food preservation; and (d) adopt destocking during uncertainty periods (Musetha, 2016). During drought periods, we found that farmers have to cull their herd to cope with

Table 2. Satisfaction with previous drought interventions rated by interviewees: [0] poor, [1] good, [2] very good, [3] excellent, and [–] drought event not discussed.

Drought year	Level of satisfaction with intervention						
	DL1	DL2	DL3	DL4	CL1	CL2	CL3
1983	–	0	–	0	–	1	–
1985	1	0	0	1	–	1	0
1992	0	1	0	1	1	1	0
1994–1995	2	1	1	2	1	2	1
2002–2003	2	2	2	1	2	2	1
2012	3	3	2	2	2	2	2
2016	3	3	3	2	3	3	2

the scarcity of water and fodder. Despite the reluctance by farmers to cull the herd, culling is becoming one of the most widely used drought resilience mechanisms in rural South Africa (see also [Ngaka, 2012](#)).

*‘Farmers are also influenced to cull their animals and are left with those that could cope with drought; this is done in accordance with the information from the pasture scientist who usually recommend the grazing per livestock per unit’ (DL4).*

*‘Though the farmers know [about drought resilience], the other issue is the government- the response from the government is very slow. All mechanisms are in place but the challenge is their [the farmers’] vulnerability’ (DL2).*

### *Management of drought information*

The accuracy of information about drought is as important as its dissemination. In the case of DARD, the extension officers pass on drought information to civic group leadership, who in turn call for tribunals through the chiefs’ council:

*‘From Disaster Management Unit and South African Weather Services, the message is passed to the people/farmers who are the people who are affected by disaster. The information is free to officers and they can impart it to the farmers after [it is] analyzed and interpreted’ (DL4).*

*‘Coming to farmers, the department will issue a notice, that if you are irrigating a certain percentage of hectare, they will start by saying reduce to 70% size. If it goes on and on it will come down to 50% ... going down as the drought progresses. You should remember that it is domestic water that has the priority’ (DL1).*

Extension officers disseminate information as received from DARD head office to farmers through social media, emails, and SMS.

*‘We work in terms of early warning, disaster preparedness, disaster recovery; all these are 3 in 1 at the district level ...’ (DL2).*

*‘Extension officers deliver the message [about droughts] to the farmers concerned immediately,’ (DL4).*

This is an indication that information transfer is expeditious; however, the integrity of the information is compromised because social media has the potential to distort information. Also, earlier research in South Africa has shown that only around 10% of people received drought information from extension officers, while around 70% used radio and television as the main source of information ([Ngaka, 2012](#)).

The flow of information about drought predominantly follows a top-down approach with government disseminating information to the communities, and very little information and knowledge being passed from the communities up to the national government. The reluctance of the drought management institutions at the district level to adopt ideas from community-level institutions is jeopardizing potentially sound contributions.

*‘... The government should also change the information extending or imparting methods to the community or farmers, this should be more participatory and include full use of indigenous knowledge systems. The farmers should be involved, feel and taste what is happening in their community so that they can easily adopt the results’ (DL4).*

There has also been resistance from communities to take up information advising them on drought preparedness, partly due to fatalistic and religious beliefs (Murphy et al., 2016). There is the view that a drought is an act of ‘God’ and as such nothing can be done about it.

*‘Farmers have not been taking announcements of droughts seriously as many take it as a natural phenomenon which would not last long’ (DL2).*

*‘Yes your narrative is true, the farmers do not trust the drought information from the government, but they also do not use the traditional methods anymore (for example saving food and fodder from wet years for drought years) ... and the farmers themselves are not quick enough to accept that there is this drought, they only believe it as an act of God and it will come and go. It’s not only livestock farmers who are affected, even the crop farmers ... so, farmers will still say that maybe something [some rains] will come any time soon’ (CL1).*

Thus, drought management decisions are not made based on local information obtained directly from the communities, and the communities do not always heed the warnings of drought managers. This means that community and governmental knowledge systems are not integrated well in the drought management process. Improved information flows and engagement of local communities would shorten response time to drought events and make interventions more locally appropriate. A quick and suitable response to a drought event reduces the severity of the drought impacts. Although reaction and response mechanisms depend on the skills and capacities of the institutions involved, the media platforms used in information transfer can also play a role in enhancing engagement.

#### *Water management institutions in South Africa*

The DWS and DARD are the key actors in water resources management, and more effective at the national level:

*‘The institutions which are responsible for drought management at sub-catchment level are (a) Department of Water and Sanitation – For the entire water catchment for community allocation and licensing. (b) Department of Agriculture and Rural Development through the Disaster Management Unit – Intervene by giving farmers fodder supplement for livestock, drilling irrigation boreholes, release early warning information to farmers etc. (c) Cooperative Governance and Traditional Affairs Department through the National Disaster Management Fund – Assist when the disaster declared national disaster, while the provincial chapter of the Department assists when the disaster is declared provincial disaster through Provincial Disaster Fund. The District Municipality Disaster Fund assists when the disaster is declared as municipal disaster’ (DL4).*

However, DWS's role has often been misunderstood by many water users who ask for more boreholes to be drilled. This is related to the changes brought about by the NWA.

*'... And as a department our role is no longer to supply water, we have a responsibility to support our water services authorities, in other words where they don't have funds to drill boreholes, the department will drill the boreholes and equip them, so that the people may have water at the end of the day' (DL1).*

Confusion also sometimes arises because the Department of Agriculture and Rural Development manages water for agriculture.

*'When we talk about agriculture, the Department of Agriculture provides for water related to agriculture, though you may find that agriculture falls under municipality' (CL2).*

Local-level institutions act as conduits for development; responsible linking communities to the national government, for example, community mobilization and needs identification predominantly rests in the local communities who pass on the information to district-level institutions. Furthermore, local communities are better placed to define their needs since they have local institutional memory:

*'The informal groups mitigate [impacts of] drought extremes through: (a) educating each other by exchanging experiences, e.g. drying of vegetables and use it when there is no green vegetable; (b) some they form a committee, like irrigation scheme committee, who regulate the usage of water on the irrigation scheme and cleaning the canal; even to educate each other on the need to cultivate drought resistance crops which use less water and can adapt well during drought times; (c) sometimes they form a committee like livestock committee which among others their function is to organise the fodder for the livestock community and educate each other of the rearing of drought resistance livestock like indigenous livestock which are adaptable to the area; (d) some form committees like street block committees whose role is to regulate and monitor the fetching of water in their street taps; which should be according to their agreed litres per household per day to avoid wastage. Washing can be done on the river' (DL4).*

The water supply situation has improved following the National Water Act (No. 36 of 1998).

*'The municipality installed some water pipes which go next to our houses... So, the situation is better, at least we do have something' (CL2).*

Within the local-level institutions are the civic groups, the royal council, farmers associations, and water user groups. The civic group reports to the headman and to the royal council.

*'The Civic Group is an organization that looks at all things to do with development in the community' (CL2).*

The nature and composition of the civic group are such that key developmental issues (such as education, social welfare, water and irrigation) have individual representatives:

*‘The operation and maintenance of the water supply infrastructure, e.g. fixing pipe bursts, are reported by a singled-out member of this group’ (CL3). ‘The water operator usually reports to the civics [civic group] and traditional council; if the matter needs further attention it may be reported by the water operator to the Water Service Authority (Municipality) and Department of Water and Sanitation’ (CL2).*

Further to the composition of the Civic Group, one representative is linked to the Local Municipality.

*‘There is a councillor who represents the municipality within the community, if there is a problem; we invite him to our tribal court, that’s when we tell him about the problem so that he can take it up’ (CL2).*

There has been a lack of involvement of local-level institutions in drought management in South Africa. For instance, in Folovhodwe village, churches and non-governmental organizations have not significantly supported the operations and activities of the government during droughts:

*‘We don’t have other players like church groupings who help during drought times’ (DL4).*

However, churches have been indirectly involved with farmers elsewhere.

*‘As far as churches are concerned, in some areas [not in Folovhodwe Village] there are churches which started some farming projects like goat and poultry farming for their members who are vulnerable to drought’ (DL4).*

The drought adaptation measures as received from the district- and national-level institutions are implemented by the Royal Council:

*‘The Council in connection with the civic associations discuss drought adaptation measures, and when they need advice or intervention, request the Municipality Councilor and/or the officers concerned’ (DL4).*

#### *Institutional coordination in drought management*

Government departments at the district level and community-based organizations complement each other in drought management.

*‘... The traditional council, civic associations and community leaders are the mouthpiece and represent the community at the municipalities, either local municipality or district municipality; and at local and regional departmental offices e.g. Department of Agriculture and Rural Development or Department of Water and Sanitation’ (DL4).*

The complementary roles of different departments and institutions take both vertical and horizontal directions. Vertical collaboration occurs between district and community institutions, while horizontal collaboration occurs among institutions at either district-level or community-level institutions.

According to Raffaello & Morris (2016), in South Africa, horizontal collaboration has been going on efficiently mainly because of communication proximity among institutions and limited bureaucracy.

The Joint Organizing Committee (JOC) plans intervention strategies at the district level. The interventions are undertaken by managers and specific disaster practitioners from sector departments and all representatives such as local chiefs, business people, and civic society.

*‘... There is a JOC forum where all departments come together and analyze how to mitigate and make awareness. Other institutions and/or departments who can assist are the Transport Department, Department of Health, DMU MRF, CMF, Universities and other research institutions’ (DL2).*

Furthermore, structures exist supporting healthy working relationships between the civic group and other entities including arms of government:

*‘The civic group interacts with the royal council on the one hand and with the extension officer and the water user association on the other hand, but this depends on the better relationship between the institutions. If the relationship is good, usually they gave reports on the traditional council meetings including other development matters’ (DL4). ‘... If something related to agriculture happens in his [extension officer’s] absence, the one responsible for agriculture in the civic group will relay the information via telephone [to the community], but between Monday and Friday the extension officer will be around’ (CL2).*

### *Drought management barriers*

Management of droughts in South Africa is facilitated by a number of enablers, although impacted upon by several barriers. The enablers and barriers to drought managed at different operational scales are shown in Table 3.

The community does not seem to understand the specific reasons behind water shortages. This is mainly because they see water in the dams and some would be flowing downstream. Consequently, shortages of water for agriculture and domestic use are associated with crime and conflict among members of the community.

*‘... It’s just a dam [water tank] that’s supposed to provide water is small in a way that most of us cannot get water at the same time...’ (CL3). ‘It has happened that some people ploughed some vegetables at home; they were stealing water during the night, those responsible [the headman] found them and they were called to the tribal court where they were punished ...’ (CL2).*

On the other hand, land in rural South Africa is the single largest limiting resource which is usually associated with limited grazing land and water resources.

*‘Land is the only resource which is limited, you can’t increase land’ (DL2).*

A proposal was made by DARD for all districts in South Africa to use a communal cattle kraal (a place where cattle are pooled, fed, and managed by the government and farmers conjunctively).

Table 3. Results on enablers and barriers to successful drought management.

Community-level enablers	Community-level barriers
<ul style="list-style-type: none"> <li>• Community leadership structures</li> <li>• Available extension services</li> <li>• Constituted farming communities</li> <li>• Water use pressure groups</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of knowledge about management of droughts</li> <li>• Lack of skilled human capital within the communities</li> <li>• Financial constraints</li> </ul>
District-level enablers	District-level barriers
<ul style="list-style-type: none"> <li>• Disaster management committees</li> <li>• Available drought management information</li> <li>• Water management institutions</li> </ul>	<ul style="list-style-type: none"> <li>• Bureaucracy – decision-making takes long due to departmental consultations</li> <li>• Financial management – including misappropriation of financial resources</li> <li>• Limited information and communication</li> </ul>

This proposal could reduce the impacts of droughts on individual farmers because of the associated economies of scale.

In the early 1980s, springs were used as an alternative source of water; however, they have lately not been an option since all have dried up:

*‘Springs are no longer giving out water. They were last used in 1992 as sources of water’ (CL2). ‘Folovhodwe area is too dry and found in arid ecological zones. Even if there are springs their support from the rain will be low because there is scarcity of rain in that particular area’ (DL4).*

The challenges faced by government departments during droughts range from the lack of enough funding for agricultural operational issues to management of agriculture infrastructure.

*‘The problem normally faced is that the orchards are fenced and normally the villagers cut the wire or some wild animals knock down the fence and the community gathers so that they find out how they can solve the problem’ (CL1).*

Despite the barriers described, drought governance in Limpopo province is enabled by a variety of water infrastructures. These include boreholes, water treatment works, reservoirs, and canals, which facilitate the provision of water for domestic uses and for agriculture. Drought information management further enables drought risk reduction. The information is relayed from the South African Weather Services department through DARD.

*‘Every morning there is some broadcasting from South Africa Broadcasting Corporation (SABC) indicating that there is drought and therefore farmers must do this and that’ (DL2).*

Such information is not broadcast as a weather forecast but rather as news to the nation. Above provision of news for farmers and communities, the government further offers subsidies on fodder to sustain livestock and complement provisions by farmers during drought times:

*‘The government sold fodder at subsidized price during drought times, for instance, a Bag of 50 kg worth R70.00 was sold for R16.00 to farmers ... Again during drought, you can see themselves [farmers] cutting grass by the road side; even the livestock farmers do collect hay and breed cattle’ (DL4).*

If drought is looming, as alerted by the Department of Agriculture, the local community leadership ensures that the communities are fully informed about the temporal extent of the drought and the need for water conservation. On the other hand, communities are engaged by the government during drought times as a way of alleviating the drought impacts. Among other things, ‘food-for-work’ has been used for such a purpose.

*‘Most of the people have been hired to work so that they can get food’ (CL2).*

In Folovhodwe, people are usually hired to rehabilitate the irrigation canal and the fence of the irrigation scheme.

## Discussion

The [Water Research Commission \(WRC\) \(2017\)](#) asserts that recurrent droughts have put strong political pressure on meteorological services and early-warning systems to produce reliable forecasts. Notwithstanding improvements in the reliability of the climate forecasts, the occurrence of drought and related risks have to be accepted and integrated into land use systems sustainably under the present climate conditions ([FAO, 2004](#)). From our results, it seems that there has been improved awareness and preparedness for droughts by both the government and the communities in South Africa since 1998. This is evidenced by several measures such as the disaster management plans which have been put in place, benefiting the nation in a number of ways. However, it is often deemed that the implementation of drought mitigation programs is still not well coordinated ([Vicente-Serrano et al., 2012](#)). The distribution of financial and material resources for mitigating the impacts of droughts within and among national- and local-level institutions needs further improvement. Furthermore, education, training, research, public awareness, and communication on drought management require more attention and should be reinforced long before a drought occurs in a pro-active way ([DMP, 2005](#)). Despite calls for better risk management approaches at all levels, failure to fully understand, integrate, and learn from past efforts may undermine current and future drought response, and state-led drought risk reduction, which remains focused on a financial ‘bailout’ mentality, with little follow-through on proactive rather than reactive drought responses, seriously contributing to the vulnerability of the communities to future drought impacts ([Van Zyl, 2016](#)).

The dissonance between policy and action on the ground is not a unique failing in the South African case ([Voß et al., 2009](#)). The failure to implement policy is exacerbated by bureaucratic implementation procedures within and among government departments. For instance, most of the planning is done at the provincial/national government level where institutional memory is domiciled, without the involvement of the local community. Furthermore, information distortion and time delays compound the challenges in drought information management. According to the DMA, national, provincial and local government and other disaster management role players should consult one another and coordinate their actions on matters relating to disaster management through the JOC ([DMP, 2005](#)). However,

because of the reactionary approach to disasters and the bureaucratic tendencies, community-level institutions are often not consulted at all, but rather just advised on drought interventions (Kapfudzaruwa & Sowman, 2009). This approach does not integrate stakeholder inputs during times of droughts; hence, efforts are not coordinated. The JOC operational constraints, which have resulted in responses to drought being reactive due to the lack of proactive measures, culminated in an ineffective drought management process (DMP, 2005; Hassan, 2013). State-led drought risk reduction, which remains focused on a financial ‘bailout’ mentality, with little follow-through on proactive rather than reactive drought responses, is also seriously contributing to the vulnerability of South Africa to future drought impacts (DMP, 2005; Vogel et al., 2010; Vogel & Olivier, 2019).

The National Water Act of 1998 recognizes the Civic Associations, Water Users Associations, and the Local Municipalities as key water actors. Despite the provision of water by DWS and the local municipalities, other stakeholders like national government departments (e.g. Department of Health, Department of Agriculture and Rural Development, Human Settlement, and Social Development) do not have an active role in the management of water resources, particularly during droughts when water use is very critical (WRC, 2017). Notwithstanding the interrelation between and among water management institutions in South Africa, the cohesion of their different roles is more pronounced at the provincial and national level than at the local municipality/district level (Swatuk, 2010). This is because community leadership is not obliged by the NWA to be involved and decide on water resources management (Kapfudzaruwa & Sowman, 2009). Consequently, the way national level and community-level institutions ‘speak to each other’ does not significantly reduce the vulnerability of communities to droughts.

Recurrence of droughts in Vhembe district has prompted communities to seek a better understanding of drought and drought risk reduction alternatives. However, the communities still struggle to distinguish the different types of drought as stressed through a mixed understanding of drought (Wilhite, 2016). This emanates from the increased complexity of the interpretation of what a drought is including what drives a drought situation. Some members of the community see and interpret drought as a period of insufficient water and rainfall, others as an agricultural drought, others as a result of poor governance in the distribution and access to water (Vogel & Olivier, 2019), often depending on their interaction and reliance on water from different sources (e.g. soil moisture for agriculture, groundwater for domestic use, etc.). For local communities, however, drought takes on many forms and faces driven in part by failing rains, but also exacerbated by a range of practices and governance processes both those from the past (during the apartheid period) and more recently.

Prior to 2000, many rural communities had not implemented government-led drought mitigation measures; only a variety of uncoordinated strategies. Even the Department of Agriculture and Rural Development and other stakeholders like the Department of Health, Human Settlement, and Social Development and Department of Transport were not proactive toward disaster risk reduction (DMP, 2005). Post year 2000, droughts were better managed and coordinated following the enactment of The Disaster Management Act (57 of 2002) and the National Drought Management Framework of 2008, among other initiatives. The DMA is seemingly coherent; however, its implementation when it comes to coordination with the grassroots informal drought management institutions remains a cause of concern (Maferethane, 2012).

The Department of Agriculture and Rural Development in South Africa cannot claim any portion of water for agricultural purposes during drought times, according to legal provisions. However, if the Department of Agriculture and Rural Development was able to provide a lifeline amount of water to

communal farmers during drought periods, the severity of droughts would be ameliorated. In practice, water-provision relief during droughts has been *ad hoc*, unreliable and difficult to access in South Africa (Hornby et al., 2016). Communal farmers are one such group who are reactive to droughts (Sithole, 2011); hence, a failure to build significant local drought resilience as they believe droughts are an act of God and can always find a way out when a drought starts. Thus, rural communities are exposed to the adverse effects of droughts.

During drought, communities do not solely depend on the government for water and food for both people and animals. Instead, the civil society mobilizes voluntary relief through platforms such as social media, rallying both private and corporate donors (Pillay & Musana, 2011). This is a demand-driven approach to disaster risk reduction, a sign that communities may not solely rely on the national government for drought intervention. In South Africa, initiatives like ‘Operation Hydrate’ coordinate water donations and delivery nationally, while ‘South Africa Drought Relief’ coordinates delivery of livestock feed, water and other essential items such as school shoes, warm clothes, and blankets (Hornby et al., 2016). Therefore, drought impacts are reduced from among the local communities as well. However, community initiatives have not proven to be sustainable because of local capacity constraints such as non-availability of logistical support among other things. The drought impact becomes more severe if the government itself experiences similar challenges. For example, the government’s 1991/92 drought assistance revealed serious administrative and logistic deficiencies in the central and regional authorities regarding the provision of water and food leading to severe hardship for communities (DMP, 2005).

Based on our findings, we summarize the suggestions for improvements in drought management both on the community and district level and on the connection between the two (Table 4).

## Conclusions and recommendations

Our research has shown that drought risk management in South Africa improved in the last decades and more legislation, procedures and institutions are in place. However, communities still face major drought issues, partly related to a lack of resources (land and funding) and partly to poor information flows, lack of education, and lack of agency. Also on the governmental level, there are operational drought management challenges that emanate from communication barriers, coordination inconsistencies and undefined, unclear actor roles and responsibilities during disasters. Drought seems to be

Table 4. Suggestions for improvements in drought management.

Community level	District level	Connection
<ul style="list-style-type: none"> <li>• Use government information for more proactive drought management</li> <li>• Use private and NGO drought relief programs effectively</li> </ul>	<ul style="list-style-type: none"> <li>• Provide emergency water supply during drought</li> <li>• Organize a communal cattle kraal</li> <li>• Provide training and education about drought</li> <li>• Listen to community-level actors</li> </ul>	<ul style="list-style-type: none"> <li>• Better two-way information flow between government departments and between government and community</li> <li>• Better coordination</li> </ul>

managed in a very top-down manner and there is little engagement of communities in decision-making. On the other hand, communities are sometimes reluctant to take up information or advice from government representatives and more training is needed.

Drought management cannot be articulated solely by the national government since provincial and local communities and institutions have a stake in drought governance. Furthermore, efforts by all stakeholders must be well coordinated for effective intervention. Coordination is evident in water governance institutions in South Africa; however, the prevalent top-down approach in lines of command is the major challenge between local-level and district-level water actors. Thus, the success of the national water governance endeavors depends on effective institutional interaction and relationships between and among water institutions. Despite the dissonance in governance among communities, drought governance has significantly improved since 2002 implying increased resilience to droughts. Without the local institutions, the government cannot effectively facilitate the building of local drought resilience knowledge and practice. Communication of drought information cannot be left to institutions at the national government level only, but rather there is a need for both intra- and extra-institutional level communication. Dissonance in drought management stifles efforts of all stakeholders to an extent that building future resilience to drought is compromised.

The South African government needs capacity and expertise to respond timely and effectively to drought across various farming communities, especially those with limited resources. A rigorous monitoring and evaluation mechanism should be put in place to ensure that lessons learnt are incorporated into future drought interventions. Further research could analyze the political economy of the local communities in South Africa in order to improve understanding of the functioning of the governance system, and why it currently seems to fail to support a permanent risk reduction approach to droughts. Thus, the health of the relationship between local communities and the local municipality could be investigated.

### **Author contributions**

All co-authors (E.M., M.R., S.R., R.D., C.V., L.M., L.McE., and A.V.L.) were involved in the conceptualization and methodology of the paper. E.M. conducted the data collection and analysis, and prepared the manuscript with input and final editing from all co-authors, and continual input from A.V.L. throughout.

### **Funding**

This research was funded by NERC, ESRC and AHRC under grant number NE/P016049/1.

### **Acknowledgements**

The authors thank their local partners and co-facilitators in South Africa for helping with the field seasons: Professor Edward Nesamvuni, Livhuwani Ludick Khobo, Tshimangadzo Mandoma, Ndivhuwo Makhlimela, and Khutadzo Ndwambi. Finally, the authors are indebted to the chief and the community of Folovhodwe for welcoming them into the community for the study.

## Conflicts of interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

## References

- AghaKouchak, A., Feldman, D., Hoerling, M., Huxman, T. & Lund, J. (2015). Water and climate: recognize anthropogenic drought. *Nature News* 524(7566), 409.
- Baudoin, M. A., Vogel, C., Nortje, K. A. & Naik, M. (2017). Living with drought in South Africa: lessons learnt from the recent El Niño drought period. *International Journal of Disaster Risk Reduction* 23(2017), 128–137.
- Botai, C. M., Botai, J. O., Dlamini, L. C., Zwane, N. S. & Phaduli, E. (2016). Characteristics of droughts in South Africa: a case study of free state and North West Provinces. *Water* 8(2016), 439.
- Davies, S. (2000). Effective drought mitigation. In: *Drought: A Global Assessment*. Wilhite, D. A. (ed.). Routledge, London, pp. 3–16.
- Disaster Management Plan (DMP) (2005). *Disaster Management Plan*, 7th edn. Department of Agriculture, Republic of South Africa. Available from: [https://www.gov.za/sites/default/files/gcis\\_document/201409/2005dmp.pdf](https://www.gov.za/sites/default/files/gcis_document/201409/2005dmp.pdf)
- FAO (2004). *Chapter 2: Biophysical characteristics*. Available at: <http://www.fao.org/docrep/008/y5744e/y5744e05.htm> (Accessed April 28 2018).
- Faysse, N. (2005). *An Assessment of Small-Scale Users' Inclusion in Large-Scale Water User Associations of South Africa*. International Water Management Institute Research Report 84, 2005.
- Hassan, R. (2013). Drought management strategies in South Africa and the potential for economic policy instruments. In: *Drought in Arid and Semi-Arid Regions*. Schwabe, K., Albiac, J., Connor, J., Hassan, R. & Meza González, L. (eds). Springer, Dordrecht, pp. 375–390.
- Hornby, D., Vanderhaeghen, Y., Versfeld, D. & Ngubane, M. (2016). *A Harvest of Dysfunction: Rethinking the Approach to Drought, Its Causes and Impacts in South Africa*. Oxfam South Africa, Johannesburg, South Africa.
- IPCC (2013). *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA.
- IPCC (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA.
- Kapfudzaruwa, F. & Sowman, M. (2009). Is there a role for traditional governance systems in South Africa's new water management regime? *Water SA* 5(5), 683–692.
- Luker, E. & Rodina, L. (2017). *The Future of Drought Management for Cape Town: Summary for Policy Makers*. Institute for Resources, Environment and Sustainability, University of British Columbia, Vancouver, Canada.
- Maferethane, O. I. (2012). *The Role of Indigenous Knowledge in Disaster Risk Reduction: A Critical Analysis. A mini-dissertation for the degree of Master of Development and Management*, North-West University, South Africa.
- Masih, I., Maskey, S., Mussá, F. E. F. & Trambauer, P. (2014). A review of droughts on the African continent: a geospatial and long-term perspective. *Hydrology Earth Systems Science* 18, 3635–3649. <https://doi.org/10.5194/hess-18-3635-2014>.
- Murphy, C., Tembo, M., Phiri, A., Yerokun, O. & Grummell, B. (2016). Adapting to climate change in shifting landscapes of belief. *Climatic Change* 134(1), 101–114.
- Musetha, M. A. (2016). *The Impact of Climate Change on Agricultural Crop Production in the Vhembe District Municipality, Limpopo Province South Africa. Masters Dissertation*, University of South Africa, South Africa.
- Mwenge-Kahinda, J., Meissner, R. & Engelbrecht, F. A. (2016). Implementing integrated catchment management in the upper Limpopo River basin: a situational assessment. *Physics and Chemistry of the Earth* 93, 104–118.
- Ncube, P. & Chisvo, M. (1999). *Regional Drought Management Strategy for SADC (South African Development Community)*. SADC Food Security Technical and Administrative Unit, Harare.

- Ngaka, M. J. (2012). Drought preparedness, impact and response: a case of the Eastern Cape and Free State provinces of South Africa. *Jambá: Journal of Disaster Risk Studies* 4(1), 1–10.
- Pereira, L. S., Cordery, I. & Iacovides, I. (2009). *Coping with Water Scarcity. Addressing the Challenges*. Springer Science and Business Media, Dordrecht, The Netherlands.
- Pillay, K. & Musana, F. (2011). *Social Media: Revolutionizing Public Health and Climate Change*. Public Health Association of South Africa, Issue 2. Available from: <https://www.phasa.org.za/wp-content/uploads/2011/05/social-media.pdf>
- Raffaello, C. & Morris, M. (2016). *Confronting Drought in Africa's Drylands: Opportunities for Enhancing Resilience*. Africa Development Forum Series. World Bank, Washington, DC.
- Rangecroft, S., Birkinshaw, S., Rohse, M., Day, R., McEwen, L., Makaya, E. & Van Loon, A. F. (2018). [Hydrological modeling as a tool for interdisciplinary workshops on future drought](#). *Progress in Physical Geography* 42(2), 237–256.
- Rouault, M. & Richard, Y. (2005). [Intensity and spatial extent of droughts in Southern Africa](#). *Geophysical Research Letters* 32, L15702. doi:10.1029/2005GL022436.
- RSA (1997). Water Services Act (Act 108 of 1997). Republic of South Africa.
- RSA (1998). National Water Act (Act 36 of 1998). Republic of South Africa.
- Sithole, P. (2011). *A Comparative Study of Rural Water Governance in the Limpopo Basin*. Doctoral Thesis, University of the Western Cape, South Africa.
- Sithole, S. & Mathonsi, N. (2015). Local Governance Service Delivery Issues during Apartheid and Post Apartheid South Africa, Africa's Public Service Delivery & Performance Review. Available at: <https://apsdpr.org/index.php/apsdpr/article/viewFile/87/86> (Accessed September 7 2018).
- Smith, D. I. (1993). Drought policy and sustainability: lessons from South Africa. *Search* 24(10), 292–295.
- StatsSA (2017). Statistics South Africa. Available at: [http://www.statssa.gov.za/?page\\_id%44286&id%412328](http://www.statssa.gov.za/?page_id%44286&id%412328) (Accessed March 5 2018).
- Swatuk, L. A. (2010). The state and water resources development through the lens of history: a South African case study. *Water Alternatives* 3(3), 521–536.
- Tallaksen, L. M. & Van Lanen, H. A. J. (eds) (2004). Hydrological drought: processes and estimation methods for stream flow and groundwater. *Developments in Water Science*, Vol. 48. Elsevier Science B.V., Amsterdam, The Netherlands.
- Thompson, H. (2006). *Water Law: A Practical Approach to Resource Management and the Provision of Services*. Juta, Cape Town.
- Tyson, P. D. & Preston-Whyte, R. A. (2000). *The Weather and Climate of Southern Africa*. Oxford University Press, Cape Town.
- Usman, M. T. & Reason, C. J. C. (2004). [Dry spell frequencies and their variability over Southern Africa](#). *Climate Research* 26, 199–211.
- Van Loon, A. F., Gleeson, T., Clark, J., Van Dijk, A. I., Stahl, K., Hannaford, J., Di Baldassarre, G., Teuling, A. J., Tallaksen, L. M., Uijlenhoet, R. & Hannah, D. M. (2016). [Drought in the Anthropocene](#). *Nature Geoscience* 9(2), 89.
- Van Zyl, K. (2016). Lessons on drought in South Africa: discussion paper for drought dialogue. Available at: <https://www.greenagri.org.za/assets/documents-/Drought-dialogue-2016-/Mnr-Kosie-van-Zyl.pdf> (Accessed February 18 2020).
- Vicente-Serrano, S. M., Beguería, S., Gimeno, L., Eklundh, L., Giuliani, G., Weston, G., Kenawy, A. E., López-Moreno, J. I., Nieto, R., Ayenew, T., Konte, D., Ardö, J. & Pegram, G. G. S. (2012). [Challenges for drought mitigation in Africa: the potential use of geospatial data and drought information systems May 2012](#). *Applied Geography* 34, 471–486. doi:10.1016/j.apgeog.2012.02.001.
- Vincent, K., Cull, T. & Archer, E. R. M. (2010). Gendered vulnerability to climate change in Limpopo province, South Africa. *Gender and Climate Change: An Introduction* (I. Dankelman, ed.). Earthscan, London, pp. 130–137.
- Voß, J., Smith, A. & Grin, J. (2009). [Designing long-term policy: rethinking transition management](#). *Policy Sci* 42, 275–302. <https://doi-org.vu-nl.idm.oclc.org/10.1007/s11077-009-9103-5>.
- Vogel, C. & Olivier, D. (2019). [Re-imagining the potential of effective drought responses in South Africa](#). *Reg. Environ. Change* 19, 1561–1570. <https://doi-org.vu-nl.idm.oclc.org/10.1007/s10113-018-1389-4>.
- Vogel, C., Koch, I. & Van Zyl, K. (2010). [A persistent truth – reflections on drought risk management in Southern Africa](#). *Weather, Climate, and Society* 2(1), 9–22.
- Weaver, M. J. T., O'Keeffe, J. O., Hamer, N. & Palmer, C. G. (2017). [Water service delivery challenges in a small South African municipality: identifying and exploring key elements and relationships in a complex social-ecological system](#). *Water SA* 43 (3), 398–408.

- Wilhite, D. A. (2016). *Managing drought risk in a changing climate*. *Climate Research* 70, 99–102. <https://doi.org/10.3354/cr01430>.
- Wilhite, D. A. & Glantz, M. H. (1985). *Understanding the drought phenomenon: the role of definitions*. *Water International* 10(3), 111–120.
- WRC (2017). *Vulnerability, Adaptation to and Coping with Drought*. The Case of Commercial and Subsistence Rain Fed Farming in the Eastern Cape Volume II, WRC Report number: TT 716/2/17, RSA.
- WRC (2018). <http://www.wrc.org.za/Other%20Documents/Software/test%20briefs%20etc/1514%20Water%20governance%20policy%20brief.pdf> (Accessed June 1 2018).

Received 19 December 2019; accepted in revised form 20 March 2020. Available online 16 May 2020