Do Elinor Ostrom's principles of successful institutions illuminate the challenges to participation in groundwater governance in South Africa? What limits are there to using Ostrom's principles to analyse groundwater governance challenges in South Africa?

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COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

Signature: Signed by candidate Date: 1 December 2016

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List of Abbreviations

ANC	-	African National Congress
CMA	-	Catchment Management Association
CMF	-	Catchment Management Forum
CPR	-	Common-pool resource
DWS	-	Department of Water and Sanitation
MWIG	-	Municipal Water Infrastructure Grant
NGS	-	National Groundwater Strategy
NWA	-	National Water Act
NWRS	-	National Water Resource Strategy
O&M	-	Operations and Management
PAIA	-	Promotion of Access to Information Act
PMG	-	Parliamentary Monitoring Group
WARMS	-	Water Authorisation Management System
WMA	-	Water Management Area
WUA	-	Water User Association
WRC	-	Water Research Commission
WSA	-	Water Service Authority
WSP	-	Water Service Provider
UNDP	-	United Nations Development Programme

1. Introduction and literature review

1.1.Project overview

South Africa is a semi-arid country with scarce water resources. Groundwater is drawn on, using boreholes, by a diverse array of users such as farmers, private citizens, companies and municipalities. Over half of the country's population receives water from groundwater systems; in some provinces up to 90% of people are supplied from this resource (Pietersen et al., 2011:4). Groundwater is predominantly used for agricultural production (Braune et al., 2014:14). In recent years groundwater has come to be considered a strategic resource by national government. This is because the use of groundwater can be significantly increased, as there are large aquifer systems that can be drawn on.

Groundwater governance in South Africa has, relative to surface water provisions, been historically underdeveloped. The ongoing development of a second National Groundwater Strategy (NGS) by the Department of Water and Sanitation (DWS) signifies a renewed effort by national government to enhance groundwater governance. Groundwater governance involves government as well as stakeholders and non-governmental institutions. The most recent draft of the NGS, at the time of writing, is the NGS (2016) Draft 4 document (DWS, 2016). This draft clearly signals that the aim of the new strategy is to move towards increasing participatory management at the local level. DWS states that its strategy is to increase resource user participation in the management of groundwater resources. The intended strategy of national government, as it is presently conceived, is through the "top-down facilitation of local actions" (Department of Water & Sanitation, 2016:27).

Governance can be thought of as the appropriate functioning of the decision-making authority in water allocation, regulation and management through socially acceptable institutions. The United Nations Development Programme's five principles of good governance are: legitimacy and voice, direction, performance, accountability and fairness (Graham, Amos & Plumptre, 2003:ii). In line with this, DWS aims to make groundwater governance more participative and to enable more local management. DWS emphasises the importance of enabling local stakeholder participation, considering the "thousands of small, locally-dispersed groundwater schemes" across the country (Department of Water and Sanitation, 2016:26).

The NGS Draft 4 (DWS, 2016:27) document states that, "In relation to the governance of groundwater, a very important common-pool resource, application of the Ostrom Principles would suggest that . . . [a] general approach is required". The NGS Draft 4 considers Ostrom's principles to be a suitable "general approach" to increasing local participation in groundwater governance in South Africa. This research paper thus intends to ask two questions: firstly, do Ostrom's (1990) principles help us to understand the broad groundwater governance challenges in South Africa? Secondly, what are the limits to using Ostrom's (1990) principles to understand the challenges to the emergence and development of participatory local groundwater institutions in South Africa? Governance is a relationship between government and wider society, and this relationship is fundamentally a political one (Rogers & Hall, 2003:5).

Development research in this area has traditionally focused on how common resources could be best managed by focusing mostly on the development of water systems and the related technical science of increasing irrigation efficiency. It was assumed that water resources had to be highly regulated by central institutions to prevent destruction by overuse. Thus there was minimal research into the capabilities of stakeholders and role of institutions (Ostrom & Gardner, 1993:110).

The last twenty years of common-pool resource scholarship has challenged the idea that top-down government interventions or privatisation will *de facto* increase efficiency; it began to focus more on aspects of user-driven institutions that enable communal governance to be sustained and successful (Ostrom, 1990; Agrawal, 2001:1650). Elinor Ostrom's research opened up a new field of study into institutions for governance of the commons and challenged the notion that it is impossible for individuals to address collective problems cooperatively through institution-building. She showed that local institutions for common-pool resource management can be successful, and that there are key aspects evident in the case studies that correlate with long-lasting and sustainable institutions. The evidence of successful commons management shows that centralised resource control in the government, privatised organisational models, and stakeholder-driven organisation can be successful, as well as highly unsuccessful, depending on the context (Ostrom, 1990; Berkes, 2007).

Can Ostrom's (1990) principles of effective institutions help us to understand challenges to increasing local participation in groundwater governance in South Africa? What are the limits? As national groundwater policy recognises Ostrom's principles as part of an

approach to developing a strategy for national groundwater governance, it seems crucial that we understand both how Ostrom helps us to identify the challenges to local participation in groundwater governance, and what gaps there may be when relating these principles to the South African context. DWS is increasing its focus on groundwater as a tool for increasing water supply and reliability, as well as for mitigating against drought. Groundwater is seen as a strategic resource with great potential for increased use (DWS, 2016). It is in this context that an engagement with Ostrom's principles of effective local institutions (which can be seen as "best practice" aspects of participatory local institutions) might help us to better understand the challenges to enabling local participation in the South African context. By analysing Ostrom's principles in relation to the literature on South Africa's groundwater governance challenges, which includes many thorough and internationally recognised research reports, there may appear to be challenges to local participation which Ostrom's principles do not help us to understand. In this way, this research is intended to contribute to the broader commons scholarship and to highlight some of the gaps and limitations it exhibits.

1.2.Methodology

The researcher worked at Umvoto Africa, a groundwater consultancy in Cape Town, from March 2015 to February 2016, as a research assistant and co-author of the project *Water Governance of Groundwater and Surface Water in South Africa* for the Water Research Commission (Riemann et al., 2016). During this time, she worked extensively on the research report, supervised by Dr Kornelius Riemann. She participated in two of the project Working Group meetings where the report was discussed in detail. She became familiar with the relevant policy and institutional environment, and attended two meetings each of the Hermanus Monitoring Committee and Stanford Aquifer Monitoring Committee, of which Umvoto Africa was the consultant responsible for groundwater monitoring.

Formal legislation, policies, and strategy documents, developed from 1994 to 2016 by the Department of Water Affairs (now called the Department of Water and Sanitation), have been drawn on extensively to illustrate the current and future national groundwater needs in South Africa, as well as to show the existing perceptions and paradigms regarding local institutional development for groundwater resource management. Key legal documents include: the 1997 White Paper on a National Water Policy for South Africa, the 1998 National Water Act and the 1997 National Water

Services Act. The National Groundwater Strategies (Department of Water Affairs, 2010; Department of Water and Sanitation, 2016) and the National Water Resource Strategy (Department of Water Affairs, 2013) have been drawn on extensively, as was the Policy on Financial Assistance to Resource Poor Irrigation Farmers (Department of Water Affairs and Forestry, 2004a).

Reports undertaken by the Water Research Commission, such as the Groundwater Management Framework (Riemann et al., 2011), provided important detail regarding the current institutional arrangements for groundwater management. The *South African Groundwater Governance Case Study* World Bank review of groundwater in South Africa is a key resource, providing an overview of groundwater governance in South Africa (Pietersen et al, 2011).

The focus of this dissertation is to assess the relevance and usefulness of Elinor Ostrom's principles of effective common-pool resource (CPR) institutions to a discussion of the South African context. *Governing the Commons* (Ostrom, 1990) is the text predominantly drawn on. This was undertaken in cognisance of the most recent additions and changes to the principles which were accepted by Ostrom. The focus on *Governing the Commons* was supplemented by much of Ostrom's prior seminal work (Ostrom & Ostrom, 1977), as well as her more recent writings (Ostrom, 2007; Ostrom, 2009; Ostrom, 2010), in order to present and discuss Ostrom's principles in the context of more recent findings by herself and other commons scholars.

The collection of first-hand data, that draws on local experiences, understandings and decision-making histories, would offer an in-depth comprehension of the realities faced by local stakeholders. However, a combination of time and resource constraints and the limited array of successful local groundwater management institutions in South Africa meant that this dissertation is based largely on written primary and secondary sources.

1.3.Literature review

While the study of the commons has not yet resulted in a unified theory of the commons, Ostrom's *Governing the Commons,* published in 1990, has significantly advanced this field. Ostrom's work continues to contribute to the ongoing development of a theory of the commons by identifying primary aspects of successful CPR institutions organised at the local level by resource users across the world. Ostrom (1990) found that self-organised CPR could be managed successfully if the rules are in line with local

conditions, if monitoring is undertaken of or by the users, and if there are graduated sanctions and processes for conflict resolution.

In line with the growing trend of emphasising the potential for stakeholder participation in resource governance to improve governance and increase resource sustainability, the question is asked: Considering the South African policy, institutional and regulatory context, what are the challenges to local stakeholder participation in groundwater governance? It is evident that many developing countries require government facilitation to increase participation in local groundwater governance, involving resource users and local stakeholders in previously centralised decision-making and groundwater management (Agrawal, 2001:1650).

1.3.1. The commons

Ostrom's first major contribution to the commons literature was in the development of the term 'common-pool resources'. Prior to Ostrom's addition, economic and political theory on the commons identified three types of goods: public goods (low levels of rivalry and non-excludable), private goods (excludable and high levels of rivalry), and toll goods (no rivalry and excludable). To this list, Ostrom and Ostrom (1977) added a fourth type: common-pool resource goods. They modified the conceptualisation of these goods from describing "rivalry of consumption" to "subtractibility of use": CPRs have high subtractibility of use and are highly difficult to exclude people from accessing them (Ostrom, 2010:5). CPRs include forests, fisheries and water systems (Ostrom, 2010:5). Groundwater is a CPR because multiple users can draw on the resource (subtractibility) and people cannot easily be excluded from accessing the resource (Ostrom, 1990; Theesfeld, 2010:132). The addition of this type has allowed for the in-depth study of CPR dilemmas as has never before been done.

Since the clarification of the term 'common-pool resources', game theorists, economists, life scientists and field researchers have been asking the question: How can common resources such as rivers, fisheries and shared land be managed successfully? How can cooperation be enabled and sustained by groups of self-organised individual resource users when payoffs do not change over time? Hardin (1968) argued that individuals will act out of self-interest and thus, when a resource is shared by multiple users, the outcome will be the destruction of the resource. Hardin's belief that individuals are not capable of cooperating successfully was widely shared by economists and political theorists for a long time.

This view has since been challenged by a body of work on CPR (Ostrom, 1990; Berkes & Folke, 1998; Feeny et al., 1990; Agrawal, 2001). Ostrom's research shows that individuals are capable of cooperating to address collective problems. The efforts of individuals are not always successful or sustained, but there are cases of long-term, local, self-organised resource users working together to create lasting institutions.

1.3.2. Governance

Governments are increasingly looking to decentralised, participatory resource management as a strategy to manage common resources sustainably and efficiently (Agrawal, 2001:1650). Resource management involves understanding, monitoring, making decisions and taking action to address the needs of the resource. Governance is the system of rules that guides the management process – the resource-related technical decisions as well as the social rules guiding interactions (Knüppe & Pahl-Wostl, 2013:54).

> "Governance is the exercise of economic, political and administrative authority to manage a country's affairs at all levels . . . it comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences" (UNDP, 2001, cited in Pegram et al, 2006).

The meaning of the term 'governance' has changed remarkably in recent years. The term is now much more widely used and linked to processes of development. Governance as a concept describes "power, relationships and accountability: who has influence, who decides, and how decision-makers are held accountable" (Graham et al., 2003:ii). Governance is not a government process but a process of interactions and decision making between a range of different actors: government institutions, civil society, the private sector, and various stakeholders and organisations in general. Governance can be used to describe and analyse a wide range of networks and collective action situations and levels of interactions which are often interlinked: global, national, organisational and community (Graham et al., 2003:02).

Governance can be thought of as both a product (with outputs such as effectiveness and accountability) and as a process involving institutional arrangements which enable participation and procedures of interactions. To answer the research question, the second framing or definition of governance will be used. We will be looking at governance as a process of interactions which enable cross-scale decision making, but

with the focus being on participation by local stakeholders in decision- and rule-making. Water resource governance involves linkages between formal institutions (government policy, institutional arrangements and political context) and institutions at the local level which may involve a formal or informal organising body (Graham et al., 2003:03).

Unsustainable and inadequate groundwater management is often related to the inadequate development of governance systems (Rogers & Hall, 2003; Bakker et al., 2008; Knüppe, 2011). Globally, it is recognised that the core crisis affecting water provision across countries is largely that of a failure of governance (Braune, Adams & Fourie, 2014:4). The sharing of common resources always involves multiple users drawing on the same resource in a context of government regulation. In situations where government capacity and resource user capabilities are in the process of development, governance becomes especially important, as resource management in decentralised systems can be improved through the sharing of power among stakeholders (Graham et al., 2003:5).

The concept of governance creates a space for new thinking about the relationship of government with the public. It creates an analytical space for better understanding the role that other actors have in managing challenges in society (Graham et al., 2003:6). It is important to think of governance according to the context, because the context is always a defining factor when looking at interactions between multiple actors in any sector.

1.3.3. Participation

The apartheid style of governance involved highly centralised decision-making in national government. The post-1994 project of national development continued to be a state-driven and a relatively centralised process of planned development. The politics of the African National Congress (ANC) government was that of transformation and democratisation; many national objectives focused on the redress of the unequal provision of public goods such as municipal services, including water and sanitation. The desire to make governance more inclusive and participatory is reflected across government policy in South Africa (Ribot, Chhatre & Lankina, 2008:8). New policies across government departments placed huge emphasis on participation, which mostly took place through stakeholder consultations, and public participation in strategy and policy development.

In South Africa, the water resource management governance structure is in the process of being adapted into a more participatory model through decentralised institutional arrangements (Department of Water and Sanitation, 2016). There is a group of resource management and commons scholars, such as Burke and Moench (2000), who present stakeholder participation as a viable governance strategy for developing countries Burke and Moench (2000) emphasise the value of creating groundwater governance strategies that are overtly participatory in nature due to the nature of the resource. In *20 Years of Groundwater Research, Development and Implementation in South Africa* Braune et al (2014:4) explain this particularly well saying that:

> "Because of its ubiquitous nature and relative ease of local access, there are widely distributed and generally dispersed abstraction points and many stakeholders, who are involved in its development, use, as well as misuse. This complicates the traditional national approaches to resource regulation and requires a very high degree of participative management. It also requires novel approaches to the systematic planning, financing and implementation of hundreds and even thousands of small, locally dispersed groundwater schemes."

Burke and Moench (2000) also suggest that while participation is widely beneficial for commons governance, there are serious challenges to face if local management is to be enabled. The valuation of groundwater must increase incentives for user self-compliance, understandings and access to resource information must be increased, and education must be used to encourage local management. These core aspects require supportive legislative frameworks. This has been called 'top-down facilitation of local actions' (Foster, 2006, in Braune et al., 2014:5). Stakeholder participation in resource management is a hybrid governance structure that operates across levels of government. Increasing the ease in which local stakeholders can engage in management and monitoring of resources can work, if these are part of wider governance systems of cooperation with clear rules for use (Theesfeld, 2010:136). This requires a "facilitative political regime" where government officials take on facilitative roles. Also essential are clear rules for operation and management, and the common perception of the importance and vulnerability of the resource (Theesfeld, 2010:137).

Illing and Gibson (2004:550), discuss the advantages of community-based organisations for rural water schemes. They argue that the localised nature of the management

activities lends itself to local action as information is gathered and processed at the local level. They note that there is evidence of decreased levels of vandalism. The proximity of the community to the resource means that malfunctions in the groundwater technology can be seen to immediately. They also note the potential for community management to entail job opportunities.

Grafton (2000) compared common-pool resources that were managed by state, community groups and private companies; he found that successful management occurs in each when rules correspond well to the resource system and when there is user participation. Grafton (2000:515) emphasised this when he found that "a common factor in ensuring successful governance of CPRs is the active participation of resource users in the management of the flow of benefits from the resources". Brooks et al. (2006) likewise found that user involvement in resource institutional and rule design is a significant factor for improving the chances of successful management with regard to conservation strategies.

1.3.4. Decentralised governance

Ribot et al. (2008) looked at the decentralisation of resource management to local levels and found that the transfer of power has been uneven and central control has been maintained in many areas of government. Ribot et al. (2008:2) say of all developing countries the local government is not often capacitated, supported, financed and given decision-making authority to engage in enabling participation in governance.

Decentralisation involves the decreasing of central control, moving decision-making power to lower levels of government. Many post-colonial African countries decentralise power to local levels as part of their strategy for broader democratic transformation (Ribot et al., 2008:2). National democratisation mandated the restructuring and developing of local government; this includes rethinking roles and responsibilities for water resource management in order to address the inequalities of access. It was believed that decentralising could lead to increases in efficiency and equity (Ribot et al., 2008:2). The notion was that local level officials would be more able to understand local contexts and challenges; due to their proximity to the communities, they would be able to better address the problems, be more accountable and be able to make governance more inclusive.

The decentralisation of decision-making power to local institutions involves political choices by central officials who make decisions on institutional arrangements, which

subsequently map and control the avenues and institutions for public participation and collective action at the local level (Ribot et al., 2008:4). The design of these institutions results in specific choices for stakeholders. When institutions are envisioned by central officials, aspects of power dynamics are embedded in the structures, and the outcome can be a failure to stimulate the cooperation and stakeholder interactions necessary to build local institutions (Ribot et al., 2008:4).

> "Governments and international organisations usually emphasise development and environmental outcomes when promoting decentralisation, and most also give high billing to participation and democracy outcomes. But, the results of their institutional choices on development, the environment or on the emergence and consolidation of local democracy often differ from stated objectives or expected outcomes." (Ribot et al., 2008:4)

For example, Agrawal and Gupta (2005:1111) suggest that where there is socio-economic inequality, decentralisation must overtly target previously marginalised people for inclusion, otherwise inequalities could be made more serious. In South Africa, the envisioning of Water User Associations (WUAs) as local committees that are obliged to include and capacitate previously marginalised target groups such as women and emerging farmers, have encountered challenges that have prevented the wide-spread adoption of this institutional model. The challenges, which will be discussed in detail in Chapter three, have had the effect of significantly reducing the success of the decentralisation of resource management to the local level.

Government policy and laws, which have tried to create a model for local institutional arrangements, are encountering many blockages and slow-downs across government levels. Despite this state support for decentralization and participation is still widely seen as part of the solution. Communities of resource users are highly unlikely to be capable of addressing resource and broader ecological problems on a large scale, without the support of government institutions (Berkes, 2000). Berkes looks at resource management as an area of activity that is not entirely local or regional but "cross-scale in both space and time" (Berkes, 2000:1). Due to the scope of resources and levels of regulations, resource management frequently requires partnerships between government and local-level groups. Berkes (2000:1) argues that capabilities can be learnt at a faster pace at the local level than in centralised institutions.

> "Given the significance of cross-scale institutional linkages, it is surprising that so little research has been carried out in this area. There is a large literature on common property institutions, and a growing base of mostly empirical literature on co-management, but relatively little on cross-scale institutions per se. There is a need for theoretical and empirical studies that focus on institutional needs for the management of cross-scale problems" (Berkes, 2000:2).

The term co-management is a concept that is used to signify the dynamics and arrangements of resource users and governmental institutions. This term has been widely used in the commons literature (Berkes & Folke (eds.), 1998; Berkes, 2002; Yandle, 2006; Cinner et al., 2009). Co-management institutions include cross-scale partnerships that bring together local institutions and government in multi-stakeholder bodies. These bodies can be essential for leveraging resources and government funds for resource management activities.

1.3.5. Groundwater governance

Research into user-driven governance of groundwater is not extensive, but some recent work has focused on this resource. Schlager (2007) looked specifically at community management of groundwater for irrigation and argued that governments should encourage local level governance of groundwater schemes, emphasising the potential of these linkages across governance levels. Theesfeld (2010) conducted a review of the policies and challenges to sustainable groundwater governance. Theesfeld's focus on the national policy level, together with the groundwater resource characteristics and related requirements, makes her analysis especially helpful for illuminating links between policy and groundwater resource characteristics. Theesfeld's (2010:133) categorisation of three distinct policy instruments of groundwater governance is especially relevant: regulatory – which involves property rights and regulations; economic – which involves incentives; and voluntary or advisory – that requires stimulating behavioural changes without using incentives. Theesfeld concludes by identifying six institutional aspects which appear to be general challenges for groundwater governance across national contexts: "voluntary compliance; tradition and mental models; administrative responsibility and bureaucratic inertia; conflict resolution mechanisms; political economy; and information deficits" (Theesfeld, 2010:131).

The literature suggests that while it is clear that local governance and user participation in institutional design is potentially beneficial, there is still much room to expand research into this area. While governance as a concept has come to take on a more democratic meaning, signifying the importance of interactions between decision-making levels and between government and non-government stakeholders, processes of decentralisation in developing countries still have a long way to go. The national political project to decentralise and democratise resource governance structures will need to move away from the high-level design of local institutions towards a conceptualisation of groundwater resource governance as a cross-scale system, where partnerships between government and stakeholders are necessary, as is government support and facilitation to local attempts at institutional design.

The next chapter will provide an overview of Ostrom's (1990) principles and her contribution to scholarship on the commons. Ostrom's (1990) principles are essentially aspects of successful local user-driven institutions and, as such, could provide insight on how, in the context of decentralised resource governance such as in South Africa, we can best understand the challenges to the facilitation and development of local institutions for groundwater governance.

2. Elinor Ostrom's (1990) principles of successful institutions

The previous chapter highlighted the increasing international focus on good governance, and particularly stakeholder participation, as crucial for the improvement of water resource management and sustainability. Contrary to the dominant view of her time, Ostrom (1990) stated firmly in *Governing the Commons* that resource users are capable of solving challenges of the commons through collective action. Ostrom's work and much of the related CPR studies have shown that, while government is an important role player, local user participation, active involvement in rule-making and decision-making is key to addressing CPR problems and sustaining the systems over time (Ostrom, 2010:24). Individuals are capable. Governments should enable and facilitate the creation of institutions that make sense for people.

Top-down government control and resource privatisation are not the only methods of governing the commons. Ostrom (1990) insisted that people should not shy away from complexity; simplified models cannot be universally applied; the future of commons research lies in identifying and embracing complexity in developing new theories and approaches to understanding the governance of the commons. Solutions to commons problems will vary according to each ecological, social and political context. Some resource problems require local action, some require national action and some, such as global warming and climate change, require international action. The role of government also differs in various contexts; in some cases, centralisation may be the best tactic and in others there may be no need for government support at all.

Ostrom's (1990) research shows that effective institutions are ones in which people are able to make their own rules and adapt them over time. Garrett Hardin's (1968) "Tragedy of the Commons" model depicted people as incapable of cooperation and the commons as destined for destruction without government regulation or privatisation. Hardin's model (1968) resulted in the widely accepted assumption that people are relatively helpless and need an external authority to provide solutions. Ostrom showed that people have the ability to communicate and cooperate to come up with solutions by agreeing on rules and mechanisms for monitoring. In many areas people are trying to solve complex problems for themselves: "We've just got to get our language and our theories to cope with those kinds of problems rather than just the oversimplified ones that are in the textbooks sometimes" (Ostrom, 2011).

Ostrom (2011) argues that the commons is a complex web of social and ecological dynamics and that trying to identify simple solutions is an unhelpful abstraction. What is needed is the recognition that society is complex and that we need political and economic approaches are needed to embrace and work with this complexity. Sustainable resource management is only possible if academic thinking changes and develops multi-level, cross-disciplinary thinking that aims to understand complexity and not reject it. People often disagree and finding mechanisms to gain common understanding is very crucial. Ostrom says, "I think now we have gained a much greater respect for human ingenuity, creativity, capacity to come up with many kinds of solutions to challenging problems, and people can" (Ostrom, 2016).

2.1. Ostrom's *Governing the Commons*

Perspectives on how to manage the commons have changed significantly over the last few decades. From resource use control through full state regulation and resource privatisation, it is now more generally accepted that local institutions can be successful. The central challenge of the commons is, after all, one of organisation: how to control the use of the commons to prevent overuse and damage to the resource. This entails the developing rules of how to use the resource, and rules around the interactions of the resource users.

Ostrom (1990) has contributed to an answer to this question by identifying institutional aspects/principles of successful local CPR institutions. *Governing the Commons* was Ostrom's (1990) first effort to bring together the knowledge generated in specialised fields by many authors, in order to formulate a better understanding of the institutional aspects that enable CPR management by stakeholders at the local level. Ostrom's argument is that resource users are capable of collective decision-making and rule formation, and thus capable of successful sustainable resource management. Her interest is to discover how the capabilities of resource users can be enabled, to develop the recommendations for CPR governance at a policy level (Ostrom, 1990:7).

CPR systems are large enough so that possible users cannot be excluded from using the resource without great cost (Ostrom, 1990:30). Ostrom makes the distinction between the resource system and the resource units that are used by resource users. The unit outputs of the resource system are variable, and depend on the way the units are withdrawn from the system, as well as the management of the resource system itself

(Ostrom, 1990:30). Groundwater from aquifers, irrigation systems, aquatic resources such as fishing areas, and road systems are all CPRs. When multiple users are drawing on the same resource, there is the temptation to 'free-ride' – withdrawing more than what is sustainable, or abstaining from contributing to maintenance of the system. The most significant challenges of governing the commons are: reducing free-riding behaviour, enabling collective decision-making to agree on rules, ensuring participation and commitment by users, and creating viable monitoring systems (Ostrom, 1990:27).

2.1.1. Institutions

The concept of institutions for CPR management, which Ostrom (1990) used, encompasses a wide variety of organisational arrangements. Ostrom's conception of 'institutions' for CRP is not simply the establishment of a committee or organisation structure; it is a process of decision-making and rule making which results in the organisation of resource and human activities (Ostrom, 1990:39). These institutional-choice processes are historical and decisions are made based on decisions made previously. The existing operational rules affect the options for new rules (Ostrom, 1990:202). Ostrom (1990:51) defines institutions as

> "sets of working rules that are used to determine who is eligible to make decisions in some areas, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided, and what payoffs will be assigned to individuals dependent on their actions".

The working rules are the rules that users actually abide by, are well known to all users, and are monitored and enforced. They can be formal laws and regulations, as well as less formalised rules (Ostrom, 1990:51). The levels of rules are linked:

> "The processes of appropriation, provision, monitoring, and enforcement occur at the operational level. The processes of policy-making, management, and adjudication of policy decisions occur at the collective-choice level. Formulation, governance, adjudication, and modification of constitutional decisions occur at the constitutional level . . . it is usually the case that operational rules are easier to change than collective-choice rules, and collective-choice rules are easier to change than constitutional-choice rules (Ostrom, 1990:52-54).

Ostrom's (1990) focus was on identifying features or principles of effective common-pool institutions that seem to have a positive relationship to sustainable management of the resource. She initially attempted to find specific rules that correlate to successful institutions, but found that appropriate rules vary widely from situation to situation and are very context-dependent. No specific rules were effective in all situations. Thus, she moved 'up' a level of analysis to look at features of long-lasting institutions.

The proponents of privatisation argue that if ownership rights are divided up among users, then users can operate freely within the confines of their use rights. It can mean dividing up shares of the resource, or assigning use rights. This argument makes the presumption that external actors should impose institutions on resource users. Ostrom (1990:14) argues that neither full central control nor privatisation can be accepted as universally correct approaches. Capacities of central agencies and of local users vary across contexts. The problem should not be perceived as one of identifying one universal institutional arrangement but, rather, of identifying in what contexts certain solutions are successful and others not. She notes that many institutional arrangements fall into neither category, and have a mix of private use rights and public state regulations. Ostrom defines successful institutions as ones that enable resource users to collectively manage resources, reducing the occurrence of rule breaking (Ostrom, 1990:15).

Ostrom argues that because the nuances of resource, environmental and social characteristics at the local level can be ignored or overlooked by external agencies in their models, the efficiency of resource use can be increased through local-based action. Ostrom (1990:39) says, "As long as the appropriators stay unorganized they cannot achieve a joint return as high as they could have received if they had organised in some way to undertake collective action". The potential for joint return is tied to the ability of water users to change the rules of use to increase benefits. When far-removed central authorities approve water-use licences, and the abstraction amounts are fixed at a specified amount, then this can be seen to reduce the potential benefits of organising. The benefit might be simply to ensure sustainability of future unit output from the resource.

Collective action and the self-governance of resource users are complex processes. There can be many uncertainties: about the resource system itself, about how actions will affect outcomes. Ostrom (1990) shows that these uncertainties can be addressed by

increasing the shared knowledge of the resource system. Building institutions is a process over time, which involves a process of experimenting with different options.

The "institutional-choice situation" is the entire context of constitutional-choice and collective-choice situations, in which resource users make decisions. The collective-choice arena affects the operational decisions directly, while the constitutional-choice arena indirectly affects the operational decisions by providing limits and enabling factors for the collective-choice arena, such as which actors have decision-making power and what property rights laws govern the system (Ostrom, 1990:192). Situational variables affect choices made, as does the idea of rational action which the theorist uses to analyse the situation. Ostrom's theoretical perspective shows that decision processes are best thought of as "processes of making informed judgments about uncertain benefits and costs" (Ostrom, 1990:208).

2.1.2. Principles of successful institutions

Ostrom conducted "a search for regularities" to identify what principles enable CPR challenges to be overcome (Ostrom, 1990:24). Ostrom analysed case studies of successful and unsuccessful collective action institutions organised around a variety of different resource types, across many countries and in complex social contexts. In all cases the resource users were "heavily dependent on a flow of scarce resource units for economic returns" (Ostrom, 1990:182). With the data, Ostrom began to provide answers to the question of what aspects of institutions enable successful management of CPRs by resource users. She does this by identifying why some attempts at organisation fail and others succeed.

Ostrom identified robust institutions as those in which rules were agreed on and operational management was organised; these rules have been adapted over time through a process of learning from action (Ostrom, 1990:58). The rules vary extensively, but the presence of commitment and monitoring are evident in all successful cases. Many of the case studies involve extensive investment in monitoring. In all of the case studies, monitoring is done by the users themselves, not by external agencies (Ostrom, 1990:59). The contexts of the CPR may vary widely, but uncertainty and complexity are features of all CPR situations. Ostrom's design elements are positively related to the sustainability of institutions and the resource. In *Governing the Commons,* Ostrom details eight principles (Ostrom, 1990:90). More recently, Ostrom has accepted the changes made by Cox et al (2009) who expanded her principles. She provides an updated version of the principles:

> "1A. *User Boundaries*: Clear and locally understood boundaries between legitimate users and nonusers are present.
> 1B. *Resource Boundaries*: Clear boundaries that separate a specific common-pool resource from a larger social-ecological system are present.
> 2A. *Congruence with Local Conditions*: Appropriation and provision rules are congruent with local social and environmental conditions.
> 2B. *Appropriation and Provision*: Appropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits.
> 3. *Collective Choice Arrangements*: Most individuals affected by a resource regime are authorised to participate in making and modifying its rules.
> 4A. *Monitoring Users*: Individuals who are accountable to, or are, the users monitor the appropriation and provision levels of the users.
> 4B. *Monitoring the Resource*: Individuals who are accountable to or are the users monitor the condition of the resource.
> 5. *Graduated Sanctions*: Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule.
> 6. *Conflict Resolution Mechanisms*: Rapid, low cost, local arenas exist for resolving conflicts among users or with officials.
> 7. *Minimal Recognition of Rights*: The rights of local users to make their own rules are recognised by the government.
> 8. *Nested Enterprises*: When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organised in multiple nested layers" (Ostrom, 2010:13).

The common understanding among resource users that there is a challenge or situation requiring action, and that alternative rules are necessary, is essential. It is necessary that the majority of the users will face similar consequences if the rules change. The users must place a high value on the resource and there must be "low discount rates". The expense of gathering information, undertaking transformation and setting up monitoring mechanisms should not be too high. If there is potential for social capital to be developed due to similar notions of reciprocity and trust, and the user group is small and relatively static, then success is more likely (Ostrom, 1990:211). Ostrom argues that the principles do apply to developing country contexts, and are cognisant and inclusive of the specificities of the problems of development facing developing countries (Ostrom,

1990:61). She found that in many of the robust case studies, the institutional arrangements were "rich mixtures of public and private instrumentalities" (Ostrom, 1990:182). Ostrom's purpose in defining these principles was to begin to contribute to a theory of the commons to help people to manage themselves and their vital resources more effectively.

Ostrom's principles are not a framework or model; they are simply aspects of local institutions that correlate with successful resource management across different resource and geographic/historical contexts. It is evident that the freedom for local stakeholders to make their own rules is essential for local institutional development; what rules they make should be related to the context and conditions of the resource. Important too is that free riding is reduced, monitoring arrangements are agreed on and commitment from users is secured. Political solutions must embrace this complexity and support localised actions, as there is no institutional arrangement that will work universally. The next chapter will provide an overview of the legislative and policy provisions for groundwater governance in South Africa broadly, and for participation in local institutions specifically. By referring to the most current literature on the implementation challenges for groundwater governance, the next chapter will provide an important basis for the analysis of the helpfulness of Ostrom's principles.

3. Groundwater governance in South Africa

In the early 1900s, groundwater utilisation across the world began to increase exponentially as industry and agriculture sought to expand access to water resources for production. The exponential increase in the use of groundwater was due to "population growth, technological and scientific progress, economic development and the need for food and income" (Braune et al., 2014:1). When farmers and industrialists began to invest in extracting groundwater, there was little government regulation or central planning. This history has made instituting new rules for groundwater use fairly challenging for states, as they must try to elicit change in existing practice to encourage higher environmental standards.

The substantial increase in the use of groundwater has been termed the "silent revolution" (Llamas & Martinez-Santos, 2005:337). Globally, there has been a disparity between the significant increase in groundwater use and the focus of government, which has predominantly been on surface water governance provisions. Groundwater use has increased more moderately in African countries due to spatial, financial and technical challenges (Braune et al., 2014:2). Climate change, population growth, and economic and social development in developing countries have increased the need for and urgency of strategic resource management (Knüppe, 2011). The trend towards increasing groundwater use with little government provision for governance arrangements appears to be common across semi-arid and water-scarce countries, so much so that the trend has been termed "hydroschizophrenia" by hydrogeologist Raymond Nace (Llamas & Martinez-Santos, 2005:337).

3.1.South Africa groundwater context

South Africa's average annual rainfall is around 464 mm a year, which is less than half the global average of 860 mm per year. The use of groundwater in South Africa has more than doubled in fifty years. In 1950 groundwater use was at 684 hm^3 and by 2004 it had reached 1770 hm^3 per year (Knüppe, 2011:69). Increased groundwater use is likely to be intensified in periods of water shortages. The 2015/2016 drought in South Africa was responded to by national government urgently through the setting up of a drought committee (Parliamentary Monitoring Group, 2016). The drought affected agriculture severely. The 2016 maize crop was the lowest crop yield since 2007. It was expected to be 25% less than the 2015 crop, which was 30% less than the 2014. Groundwater use is currently at approximately 2000-4000 million m^3/a of groundwater. Thus, compared to

the 10 300 million m³/a that can be sustainably utilised, groundwater appears to be a very significant national resource (Braune et al., 2014:11).

In the last twenty years, increasing access to water services for previously marginalised communities has been a top priority of national government; this has been undertaken successfully, in part, through significantly increasing groundwater use. Groundwater resources contribute to basic social wellbeing (such as drinking and sanitation), and combatting poverty and illness (Knüppe, 2011). Previously, the main users of groundwater were people in rural towns, farmers for irrigation and the mining industry (Braune et al., 2014). Today, over half of the newly serviced communities are serviced from groundwater resources. In provinces such as North West and KwaZulu-Natal, upwards of 80% of communities in the rural areas receive water from groundwater resources (Pietersen et al., 2011:4). For these rural communities, especially in arid areas with little infrastructure for bulk water, groundwater is essential to sustaining livelihoods and food security through subsistence and small-scale farming. Support of the management of these groundwater schemes has recently become a priority for the DWS. South Africa can be seen to have pioneered the use of groundwater for increasing access to water for rural communities (Braune et al., 2014:2).

Groundwater is also relied upon extensively in urban municipalities such as Tshwane and Mafikeng. The City of Cape Town and the Nelson Mandela Municipality are both investing in groundwater to meet future water needs (Pietersen et al., 2011:4). Groundwater also plays an important, less recognised role in ecosystems such as wetlands and river systems (Knüppe, 2011).

3.1.1. Groundwater stakeholders

Of the groundwater utilised across the country, agricultural irrigators use by far the largest share. This is due to years of private development where farmers were able to drill boreholes to increase their access to groundwater (Braune et al., 2014:14). Intensive use has resulted in over-abstraction and resource damage. Mining operations account for about 13% of groundwater use. Groundwater is used for rural water supply, and increasingly factored into urban water supply plans. Thirty-four per cent of towns use both groundwater and surface water, and 22% of the towns rely entirely on groundwater (Braune et al., 2014:13).

3.1.2. National research environment

Collaboration between the Water Research Commission (WRC) and DWS has resulted in the development of frameworks for groundwater management (Riemann et al., 2011) and groundwater and surface water governance (Riemann et al., 2016; Jonker et al., 2010). The WRC research projects in recent years have included topics focused on groundwater including: scheme management for domestic supply systems (Cobbing et al., 2014); Resource Directed Measures (Dennis et al., 2012); and protection measures review (Xu et al., 2015). Groundwater areas receiving more focus in the South African water research community include the groundwater Reserve determination (Riemann, 2013), and adaptive and sustainable groundwater management (Knüppe, 2011). A recent report for the World Bank, called *South African Groundwater Governance Case Study,* looked at the legislative and policy environment, as well as case studies of aquifer management across the country (Pietersen et al., 2011). This report is the most extensive evaluation of groundwater governance in South Africa to date.

3.2.Groundwater governance in South Africa

3.2.1. Legislation and policies

During apartheid, the designation of Bantustans and the forced relocations of black communities entailed the separation of these communities from land and water resources (Cottle, 2004:10). White commercial farmers benefited from government subsidisation and government-supported infrastructure development, particularly the building of dams (Cottle, 2004:10). The riparian water rights system meant that white landowners had the right to access the groundwater under their land freely through private boreholes, and permits were only required in select cases. Water services across the country were drastically unequal. Black communities living in the Bantustans had less access to water services and options for irrigation for agriculture were limited. Water legislation and policy in South Africa has changed considerably since 1994. Previously, national water policy was focused primarily on forestry and irrigation (Pietersen et al., 2011:5).

It was recognised that drastic policy reform was needed to address this imbalance. The Constitution Bill of Rights (Republic of South Africa, 1996) established access to water as a basic human right. It also mandated the state to take action to ensure the realisation of this right, as far as is possible, with the resources it holds. The Water Services Act (Republic of South Africa, 1997) established regulations for water services and water services responsibilities were decentralised to local level institutions (district and local

municipalities). The Water Services Policy (Department of Water Affairs & Forestry, 1997) included a plan for decreasing the backlogs of communities without access to basic water services. The White Paper on National Water Policy (Department of Water Affairs & Forestry, 1997) redefined the water property rights system. Groundwater changed from being private property to being a public asset held by the state. This model of water as a public asset held by the state was also instituted in France in 1992, Italy in 1994 and Portugal in 1994 (Theesfeld, 2010:134). In this system, water users can access water by applying for a water use licence or through their right to basic water services (Pietersen et al., 2011:5). At the same time, a new national department was established as the "trustee" of water resources, holding responsibility for water resource protection, management and water use authorisations (Pietersen et al., 2011:7).

The National Water Act (Republic of South Africa, 1998a) provided an outline of the institutional structure for water resource management and governance, based on three foremost principles of equity, efficiency and sustainability. The distinction between groundwater and surface water was not made in the Act, as all water resources were treated as one interdependent water system. Catchment Management Agencies (CMAs) were legislated to be the regional institutions for water resource management of water resources. WUAs were legislated institutional models for user-level water management activities. All existing irrigation boards were required to transition into WUAs.

It is important to note that the act clarifies that 'existing lawful use' of groundwater by stakeholders may continue. The new legislation would thus not substantially infringe on the volumes of water that were licensed to users prior to 1998. This protected the existing water use of the established commercial farmers, industry and mining and is a move that has been criticised for ensuring the continuation of water inequalities (Cottle, 2004:15). In the context of finite water resources and water shortage, the protection of existing water use limits the water available for emergent black famers, as what is available to them is the amount left over from the existing unequal allocations. White commercial farmers have another advantage: water use licence applications take into consideration "investments already made" in infrastructure, meaning that licences are likely to be granted if the stakeholder has already invested in infrastructure (Cottle, 2004:16).

3.2.2. National strategy

The National Water Act (Republic of South Africa, 1998a) mandates the development of a National Water Resource Strategy and Catchment Management Strategies as the key strategic plans for these levels of governance. The participation of citizens is a requirement of both strategic plans. The DWS has produced two National Water Resource Strategies (NWRS). The first National Water Resource Strategy set out a national implementation framework for water resource management and established 19 Water Management Areas (WMAs) (Department of Water Affairs and Forestry, 2004b). In response to some of the gaps in the first NWRS, the department developed a NGS in 2010 (Department of Water Affairs, 2010). The strategy noted that the development of groundwater resources is ideal for rural and small municipalities, because of its general good quality and resilience (Department of Water Affairs, 2010:9). While building dams and catchments for surface water is cost-intensive and requires large sums of capital, the costs of groundwater well field development are much lower and can be spread out over multiple financial cycles. DWS is currently in the process of developing a revised National Groundwater Strategy and has produced a fourth draft for public comment in April 2016. This was followed by a second NWRS in 2013 (Department of Water Affairs, 2013).

Meissner (2016) found that the stance of DWS, as evident in the second NWRS strategy (Department of Water Affairs, 2013), indicates that DWS sees itself to be the primary coordinating institution with regard to the management and governance of water resources and, more importantly, seems to present society in general as a beneficiary of the developmental progress made by government (Meissner, 2016:6-7). The second NWRS (Department of Water Affairs, 2013) does note the importance of the participation of the private sector in water resource management, but the lack of focus on local governance shows that while 'participation' was central to government rhetoric on resource management, in practice the enabling of local management was not a top priority of national strategy at that time. This seems to be changing with the development of the new NGS strategy (Department of Water and Sanitation, 2016).

3.2.3. Water institutions

South Africa is in the process of decentralising water resource management and, so, responsibility for water management lies across government levels. DWS is the national department responsible for water resource management and the DWS regional departments regulate water service authorities (local and district municipalities) at local levels. Due to uneven local and district municipality capacities, DWS is obligated to

provide support. Catchment Management Agencies (CMAs) are regional water management institutions that hold responsibility for water use authorisations, resource development and management, as well as the development of catchment management strategies (Department of Water Affairs and Forestry, 2007). DWS's goal is to have one CMA for each of the nine WMAs.

While the National Water Policy (Department of Water Affairs & Forestry, 1997) details CMAs, water boards and irrigation boards (now WUAs) as water management organisations, there is no direct mention of local-level groundwater management institutional arrangements (Pietersen et al., 2011:10). WUAs are the legislated local level stakeholder bodies for water management activities – this form of institution has typically focused on agricultural irrigation and surface water activities. Water users join together to establish WUAs according to their needs, and then invest technical and financial resources in the association. There is a management committee and the WUA can focus on different tasks such as irrigation system management or collective infrustructure development. In order to be established, the WUA requires the DWS minister to approve the business plan. As of 2013, there were 90 established WUAs and 129 water boards that still needed to become WUAs (Department of Water Affairs, 2013). The "hydroscitrophrenia" of the water sector up till now is evidenced in the fact that there are no groundwater WUAs.

Catchment Management Forums (CMFs) may be established as a sub-committee of a CMA. Their purpose is to promote community participation in the water management area with regard to management, development and protection (Pietersen et al., 2011). The CMF links stakeholders to the DWS minister so that effective action can be taken and legitimacy can be built. CMFs are envisioned as forums for sharing of knowledge and a forum for stakeholders to make recommendations to authorities. These bodies are obliged to conduct consultations to inform their stakeholder communities of proposed activities, so that they might increase stakeholder participation in water management and provide support to the CMA. As these forums work at the water management area level, they are not efficient models for local groundwater governance.

Local or district municipalities are Water Service Authorities (WSAs) and are responsible for water service planning (ensuring future water supply and access for citizens) and selecting and monitoring Water Service Providers (WSPs). WSPs can be a separate municipal directorate or a public water board or a private entity (Riemann et

al., 2011). WSPs are contracted to provide water to the WSA. The Water Services Act (Republic of South Africa, 1997) mandates the separation between the WSA and WSP, so that responsibilities and lines of accountability for water provision are clear. It is important to note that, in South Africa, institutions such as municipalities are both water services authorities (with responsibilities to ensure basic access to water) as well as water users who may draw groundwater from the same aquifer as other users such as farmers, industry or private individuals, and must likewise apply for water use licences from the CMA or DWS.

Traditional leaders usually take on a more active role in land management than water management in South Africa, but they can be important stakeholders in water governance (Tapela, 2014). Complexities of legitimacy and capacity are a reality, but recognition of the importance of indigenous knowledge and customary laws to developing sustainable water management governance systems is crucial to creating sustainable governance systems. Recognition of customary law can increase community support. Ultimately, how traditional leaders and customary law are brought into governance systems should be flexible and based on the local context (Tapela, 2014).

3.3.Implementation review

The Geological Society's Groundwater Division made a submission to parliament that said that, "An inability to implement the NWA, as a result of a lack of sufficient skilled and experienced staff, prevents groundwater from being used productively and sustainably to promote economic growth and social upliftment" (Groundwater Division, 2008, in Braune et al., 2014:63). Schreiner (2013:130) suggests that, in pursuit of implementing what is an advanced piece of legislation, the basics were never achieved – "maintaining the monitoring infrastructure, and ensuring compliance with license conditions". The DWS was not adequately capacitated to be able to implement the NWA, and this, together with a lack of leadership and accountability at high levels regarding officials meeting their targets, impacted on implementation (Schreiner, 2013:129; Knüppe, 2011:67).

The Geological Society's statement points to the lack of groundwater expertise, a problem across governance levels from national to local. Much of the groundwater expertise sits in the private sector, which then results in outsourcing. The low national groundwater expertise feeds into the continuation of the perception of groundwater as unimportant, and continued low national investment in the resource (Braune et al.,

2014:64; Knüppe, 2011). Schreiner (2013) explains that "South Africa does have a relatively high level of technical competence compared to many other developing countries", but that the transfer of technical and managerial skills out of DWS and the low capacity to implement policy at the civil servant level, due to lack of experience and technical know-how, and high ministerial and staff turnover, impact on the implementation of policy (Schreiner, 2013:131). Within DWS, individuals hold conflicting conceptions of DWS priorities: some emphasise the political priority to establishing equity, and others, particularly white officials, emphasise the prioritisation of white commercial farmers' interests based on the importance of the contribution of agriculture to the national economy.

The NWA aimed to decentralise water resource management to the "lowest appropriate level" through the establishment of CMAs, yet, since that time, only two CMAs have been established (Schreiner, 2013:126). The establishment of CMAs has been a slow process and only two are fully operational, the Inkomati-Usuthu CMA in Mpumalanga and the Breede-Gouritz CMA in the Western Cape (Department of Water and Sanitation, 2015). The idea was that CMAs would receive water use charges to manage the resources and thus would have a clear accountability to the resource users, as CMAs depend on their charges for their functioning (Schreiner, 2013:130). Schreiner (2013:130) says, "There is still an unresolved debate about what functions will be delegated to CMAs and over what time frames. The power to authorise water use is at the centre of this debate".

3.3.1. Weak institutional provisions at local level

At the local level, many irrigation boards have yet to be transformed into WUAs due to the administrative requirements for WUA establishment. WUAs are legislated institutions and require an arduous administrative process to be made an establishment. This has been identified as a constraint (Department of Water Affairs, 2013). Some WUAs that have been established continue to function as irrigation boards, without engaging in the integrated water resource management role and other responsibilities that WUAs are intended to have.

WUAs are required to be inclusive of previously disadvantaged stakeholders; their business plans must include plans for transformation and capacity development. Established farmers can resist taking on a developmental role and cite a lack of financial support as a constraint to the requirement that WUAs engage in capacity building (Pegram & Mazibuko, 2003). As WUAs must develop a business plan, knowledge of management and financing is needed for stakeholders to engage in planning. The

historical and present reality is that education levels in many parts of the country are low and so reduce the likelihood that previously disadvantaged individuals will engage in this forum. Likewise, the imbalance of financial resources between established and emergent farmers poses a challenge to equal contribution to the WUA activities, as well as participation in decision-making.

The established white commercial water users have "significant bargaining power and skills, access to the seats of power, and to legal support", but the rural poor have very few avenues to access power (Schreiner, 2013:128). The power and resource inequalities between emergent and established farmers affect the likelihood of equal participation in decision-making and the development of trust. DWS does offer support through grants and subsidies to disadvantaged members (Pegram & Mazibuko, 2003). The DWS Policy on Financial Assistance to Resource Poor Farmers (2004a) is intended to be an instrument to enable the inclusion of resource-poor farmers into the formal economy. The policy provides funding to emergent farmers who are part of WUAs, to help them become financially stable. The grants can be for irrigation construction, water infrastructure maintenance and management training within the WUA structure. Applicants for this grant are required to be part of a WUA structure; as WUAs are administratively cumbersome and costly to establish, this diminishes the potential impacts of this policy. The majority of emerging farmers are not members of WUAs and so do not have access to grants (Ncube, 2016).

The NGS (Department of Water Affairs, 2010) suggested that improvements were required in many distinct areas: the enforcement of water use licensing, improving the response to incidents of pollution of groundwater (e.g. through acid mine drainage), implementing the non-implementation of the principle of polluter pays (from National Environmental Management Act (Republic of South Africa, 1998b)) and the underdevelopment of the out-of-date groundwater monitoring network (Department of Water Affairs, 2010:5). The new NGS, still in draft form, shows a much more focused vision of government for facilitating and enabling local actions. This signals a renewed prioritisation on developing local governance of groundwater. Up until this point, government has largely seen participation in groundwater governance as participation in strategy development and consultations. It was not recognised that capacity lies across levels of society and that partnerships at the local level have great potential to decrease the costs of management for government such as WUAs and community organisations (Schreiner, 2013:130).

The literature on groundwater in South Africa shows that the development of local level institutions and arenas for participatory decision-making and rule making is still in its infancy. Groundwater expertise shortages in government, combined with existing political, social and economic inequalities between groundwater stakeholders, might suggest that government should seek new facilitative instruments. Schreiner (2013:130) states that "Harnessing the capacity and commitment of these stakeholders in determining water management priorities, finding innovative solutions, implementing actions, and monitoring implementation can go a long way to bolstering the capacity needed to protect, develop, conserve and manage the nation's water resources" (Schreiner, 2013:130).

The next chapter will begin to discuss answers to the research questions. Having outlined the basic tenants of Ostrom's principles, and the groundwater governance situation in South Africa, it is now possible to consider how Ostrom's (1990) principles can illuminate the core challenges facing local institutional development in South Africa.

4. Analysis

4.1. Do Ostrom's principles (1990) help us to understand the broad challenges to groundwater governance in South Africa?

Using Ostrom's (1990) principles, can we identify the core challenges to participation in local groundwater institutions in the context of South Africa's water policy and institutional arrangements? What areas pose the most serious challenges to progress? While Ostrom never meant for the design principles to stand as a blueprint for CPR institutions, due to the lack of a diagnostic tool for evaluating commons governance at this point in commons scholarship, her principles can be drawn on to guide analysis. The debate on whether design principles and diagnostic tools are entirely separate is beyond the scope of this paper to address. The analysis to follow is based on the assertion that Ostrom's principles can be drawn on as broad examples of "best practice" or commonly positive aspects of local institutions, in order to benchmark the arrangements in South Africa against these commonly successful aspects of local participatory institutions. The analysis will reflect on the broad material challenges, but also on the coherency and usefulness of Ostrom's principles in illuminating user groundwater participation challenges in South Africa.

4.1.1. Boundaries

4.1.1.1. Water use authorisations

1A: "Clearly defined boundaries: Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined." Ostrom's (1990) principles for effective CPR institutions have been deemed robust, but Ostrom has recognised additions to the principles contributed by Cox et al (2010). It is these additions that we will work with as they are the most recent version. The first addition was the expansion of Ostrom's principle of "clearly defined boundaries" into two principles 1A and 1B, which separate the principle into user boundaries and resource boundaries. In her early work, Ostrom (1990) makes it clear that the principle of clearly defined boundaries entails both the user boundary and resource boundary dimensions, but she collapsed them into one principle. Cox et al. (2010) made the separation in order to assess the qualitative significance of each specific aspect. They carried the distinction forward because each principle proved to be significant to the "outcomes of cases and conclusions of studies" to different degrees (Cox et al., 2010).

Ostrom (1990) found that user boundaries seem to be significantly indicative of successful institutions. Why is it so important that users define boundaries? Ostrom

draws on game theory to suggest that the reason this variable is significant to success is that users need assurance that they will get the proportional benefits from their actions, and assurance that others who do not contribute will not benefit unduly (Ostrom, 1990:91). She suggests that we can think of the collective defining of boundaries as an initial action enabling collective organisation (Ostrom, 1990:91). The benefit for the user in collective action (which requires personal cost) is the discount rate. The discount rate is the income you require to be able to continue to do future business, or the value of potential future earnings.

> "If there are substantial numbers of potential appropriators and the demand for the resource units is high, the destructive potential should all be allowed to freely withdraw units from the CPR could push the discount rate used by appropriators toward 100%. The higher the discount rate, the closer the situation is to that of a one-shot dilemma in which the dominant strategy of all participants is to overuse the CPR" (Ostrom 1990:91).

In South Africa, groundwater user boundaries are clearly delimited and legitimated through the water use licensing process, where potential users are granted access or denied access. Water use is licensed when there is a likely impact from the use; it entails the registration of the use as well as monitoring and reporting (Braune et al., 2014:26). Domestic water and stock-watering are considered Schedule 1 use and are not required to be registered (Braune et al., 2014:26). Water use licencing has seen delays and the water use registration system is outdated and contains inaccuracies. This creates challenges for billing and compliance (Schreiner, 2013:126). Users are required to register their use on the DWS Water Authorisation Management System (WARMS) database. The database requires development, as the verification of the data has been minimal. Braune et al. (2014:12) notes "many farmers have been reluctant to register their irrigation water use because they continue to see the water underneath their farm as their private property".

Registered use data shows that the majority of groundwater use is agriculture (79%), followed by water services (8.3%) and industry (5.2%) (Braune et al., 2014:26). This is not a comprehensive indication of the actual water use, because not all users have registered. Issues have arisen over the over-registering of water use, so that users could claim "existing lawful use" and be guaranteed higher water allocations (Braune et al., 2014:27). Another issue is that abstraction licences take very long to be processed,

because of the scientific inquiry necessary to ensure the protection of the wider ecological environment. This is also because of low DWS regulatory capacity (Braune et al., 2014:27). All of these factors can be seen to minimize the assurances that this principle implies is important.

4.1.1.2. Resource boundaries

1B: "Clearly defined boundaries: The boundaries of the CPR must be well defined."

The boundaries of the resource must be defined and 'closed' so that the users of the resource can be known and the use of the resource can be contained. If the resource is open for anyone to use, then the likelihood of collective action becomes very low: people will not perceive there to be any change of benefit from cooperative rule making.

All major aquifers and their geological characteristics have been mapped. Subsequently, there has been a systematic analysis and documentation of the groundwater resources by the then Department of Water Affairs and Forestry, which began in 1992, in collaboration with the WRC (Braune et al., 2014:18). The publication of 21 hydrogeological maps was undertaken from 1995-2003 and there have been two subsequent studies. Despite this, data availability is less reliable and less available than surface water information in most countries. Where there are multiple small-scale users abstracting water from private boreholes, it can be unclear as to how much water is actually being extracted. This points to the close connection between delineating resource boundaries and the monitoring of these boundaries, as the one without the other reduces the likelihood that users will see benefit in cooperation.

It should be noted here that the characteristics of the resource involve special difficulty in defining resource boundaries for the purpose of monitoring and resource protection. Aquifers exist across administrative and property boundaries and the systems cannot be divided or protected from access. Aquifer boundaries are notoriously difficult to pinpoint, due to the scientific requirements for determining recharge dimensions, discharge and flow attributes, as well as the connections to surface water (Theesfeld, 2010:133). The effects of user withdrawal are also often unclear and impacts are difficult to trace back to users. The slow hydraulic response of the resource means that, unlike surface water resources where damage is noticeable in a relatively short timeframe, damage to groundwater resources can be evident after much longer periods of time. Likewise, the restock of the aquifer may take a much longer time, or can even be impossible, depending on the type of aquifer (Theesfeld, 2010:132). The way contaminants enter aquifers is often unknown and, even if arsenic and other chemicals

are identified in the water, the source of the contaminant is often not clearly evident (Theesfeld, 2010:133). Groundwater resource damage can be irreversible, through contamination or over-abstraction, which damages the storage system of the aquifer, or through damaging the links in the water system.

Groundwater users often have unequal access to information in South Africa. The water users and water providers may have differing information in the characteristics of the resource; this has implications for the clarity of boundaries, because activities (land-based and climate-related) outside of the groundwater resource boundary can impact on the resource. This is important to note, because Ostrom (1990) is suggesting that resource users need assurances that their efforts will not be impeded by unlicensed users and other damaging activities, and this assurance is tied to their perception of future benefit, which in turn is dependent on the information they have regarding who is using the resource and whether these boundaries are being respected. It can be concluded that in South Africa while social and resource boundaries are delineated, the lack of full implementation and monitoring of these basic aspects of the groundwater governance system reduces the assurances for users that their actions might result in benefit.

4.1.2. Institutional development and rule-making

Ostrom's (1990) next few principles relate to the importance of developing rules and processes within local user-driven institutions. As there are very few local institutions for groundwater-related decision-making, this appears as a huge gap in the governance system in South Africa. The NGS Draft 4 makes it clear that the aim of the DWS is to "develop, facilitate, capacitate and support appropriate institutions that will allow effective local level participative management of groundwater resources" (Department of Water and Sanitation, 2016:58). This new push for local institutional development comes in the context where "there are no Water User Associations for groundwater and very few local monitoring committees are functional" (Department of Water and Sanitation, 2016:59). Perhaps Ostrom's (1990) principles of successful local institutions could help us to better understand what the challenges might be for the implementation of this national policy?

Ostrom's (1990:92) original principle described the importance of there being cohesion between appropriation and provision rules, and the local context. Appropriation rules organise the quantity that can be extracted, as well as the place, and technological

mechanisms utilised. Provision rules organise how the cooperative activities will be undertaken, for example, the sharing of labour, pooling of funds and the materials needed (Ostrom, 1990:92). These rules should be related to the local context. Ostrom accepts the division of this principle into two separate principles into: 2A "Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions", and 2B "The benefits obtained by users from a CPR, as determined by appropriation rules, are proportional to the amount of inputs required in the form of labor, material, or money, as determined by provision rules" (Cox et al., 2010). Ostrom (1990) emphasises that the institutional arrangements should be aligned to the situation of the resource. This principle is suggestive of the concept of adaptive management, where changes in resource dynamics are met with flexible human responses and appropriation rule changes (Cox et al., 2010). What Ostrom (1990) calls 'rules' can essentially be seen as management arrangements which set up the decision-making, and operation and management procedures regarding the appropriation of resource units from the resource.

Ostrom's third principle is that successful collective-choice arrangements entail the participation of "most individuals affected by the operational rules" who "can participate in modifying the operational rules" (Ostrom, 1990:93). Users often have the most recent and observed information regarding the resource and, so, if they join together, are best able to operate flexibly according to the resource condition (Ostrom, 1990:93). Cox et al. (2010) draw the parallel between this principle and the extensive literature on how important local knowledge is for resource management. There are very few institutions for collective-choice in management of groundwater in South Africa, yet government aims to facilitate and enable the development of this level of groundwater governance. In general the form this activity should take is in the development of aquifer management plans. How to encourage stakeholder organisation and participation in this kind of resource management activity remains unclear. The literature does point to a few key challenges to this institutional development in South Africa.

4.1.2.1. Slow institutional development across the governance system

The Groundwater Management Framework (Riemann et al., 2011) provides guidance for the management of groundwater resources. Depending on the context, effective groundwater management may entail "aquifer protection, groundwater quality management, groundwater remediation, groundwater assessment, groundwater monitoring, well field planning and design, well field operation and maintenance"

(Riemann et al., 2011). An important enabling activity for the cohesion between abstraction and the resource dynamic is monitoring, which will be discussed in the next section. This framework provides an outline of the roles and responsibilities of the different stakeholders, but is not yet widely implemented and there is a lack of understanding of the role and responsibility of local government.

Regional planning for the catchment level is moving at a glacial pace. The DWS intends that local level organisation and rule making should be supported by CMAs, but, due to the slow roll-out of these regional institutions, this is not happening. In the current groundwater governance system, appropriation rules according to regulation take the form of the existence of an agreement on aquifer management plans. Detailed aquifer management plans which stipulate the licensed abstraction quantities, the technology used, the time and place of abstractions with information of the quantity being abstracted across the aquifer, are almost non-existent in the country, with the exception of a few areas such as Hermanus and Stanford which have detailed aquifer monitoring and management arrangements.

4.1.2.2. Inadequate municipal capacity for implementing appropriation arrangements

The current mechanisms for aquifer management planning are in most cases not implemented at the local level. At the local level municipalities, WSAs must produce Water Service Development Plans to plan water services, but, due to low technical capacity and the lack of focus on groundwater by officials, planning for this resource is minimal across many municipalities (Department of Water and Sanitation, 2016:65). It is stated in the NGS Draft 4 that: “Local and vulnerable groundwater resources need a much more participative approach to development, operation and protection. This is still completely missing” (Department of Water and Sanitation, 2016:65).

In 2000, when government was decentralised, municipalities were given responsibility for groundwater schemes previously managed by DWAF and community management structures (Braune et al., 2014:46). Subsequently, it is evident that there has been significant failure of these schemes (Braune et al., 2014:46). It is not clear how many exactly, due to the lack of detailed compliance monitoring. It seems that this is primarily an issue of operation, maintenance and management, rather than issues with the resource itself. Operation and management are not particularly complicated, but require logistics such as travel between boreholes and general maintenance, which are capacities that WSPs do not always have in rural areas: “the large number of

dysfunctional village boreholes in Limpopo and elsewhere is a case in point" (Braune et al., 2014:46). Things as simple as the use of a vehicle and petrol funds to drive between boreholes are often not available. O&M budgets in municipalities are often not prioritised, due to financial scarcity, and the lack of technicians make maintenance challenging (Braune et al., 2014:48).

National DWS strategy to meet water demand has made groundwater resource use the first option for towns across the country looking to increase the water supply, due to increasing demand on the water services. Local municipalities have been hesitant to turn to groundwater, due to perceptions of groundwater as cumbersome to manage and having poor quality. The general countrywide lack of operations and management of well fields has resulted in malfunctioning groundwater infrastructure and the resulting perception that groundwater is erratic. DWS reports that over 70% of municipalities which hold water service authority responsibilities would rather have regional water schemes than local groundwater systems, due to the management requirements (Braune et al., 2014:22). Bulk water distribution requires little local capacity. Data suggests that municipalities have been utilising the Municipal Water Infrastructure Grant (MWIG) to increase access to water from groundwater systems (Braune et al., 2014:22). It is well known that local municipalities lack the technical capacity to implement groundwater operation and maintenance and that support is required (Braune et al., 2014:22). In rural areas, management requires community participation for sustainability. The aim is community management "supported by local government and facilitated by national government" (Braune et al., 2014:51).

A lack of clarity over roles and responsibilities, and low municipal capacity, also impact on the likelihood that groundwater users will feel there is a benefit to them engaging in cooperative resource governance interfaces. Principle 2B states that "The benefits obtained by users from a CPR, as determined by appropriation rules, are proportional to the amount of inputs required in the form of labour, material, or money, as determined by provision rules". Correlation or synchronicity between appropriation and provision rules is widely expressed as the dynamic between the cost of participation for users and the benefit they can expect from engaging in collective action (Cox et al., 2010). This means that the users have reason to believe that their investment of time and finances in rule creation for resource management would result in benefits. This is complicated by a lack of clarity over accurate groundwater pricing and management responsibilities, especially regarding the financial aspect. Water resource management charges are charged to all groundwater users and directed to the CMA, as the primary water

resource management institution at the regional level. The lack of CMA establishments and the need for more detailed groundwater information and monitoring leaves organised groundwater users asking the question: when modeling proves necessary, who pays for aquifer modeling?

Where groundwater is largely drawn on for municipal systems, there is the need for the rolling out of operation and maintenance guidelines to municipalities to suggest procedures and indicate the general costs of maintenance (Braune et al., 2014:48). As it stands, municipalities are allocated abstraction amounts, but the costs of the maintenance of the system are not budgeted for appropriately. WUAs are intended as resource management institutions at the local level in situations where mostly agricultural stakeholders draw on groundwater. There has not yet been a WUA established for groundwater management. Business plans are a mandatory aspect of the application, as an attempt to ensure that the participants accommodate management costs. Business plan development can involve conflicts. Due to the mix of established wealthy farmers and emergent farmers with fewer resources, there can be serious difficulties settling on the division of management responsibilities, particularly regarding funding for activities.

WUAs for groundwater are the only government-supported institutions for local rule making. Barriers to establishment include rejection of the application (due to the requirements for representivity), lack of national support to establishment, lack of district support and lack of municipal cooperation (manager attitudes/budgets) (Braune et al., 2014:54-55). Representivity seems to be a central issue, as WUA processes become dominated by established commercial famers (Braune et al., 2014:55). The lack of sustained support by DWS regional offices and non-existent CMAs are also central issues. Braune et al. (2014:56) suggest that:

> "Players with capacity, in particular municipalities, organised agriculture and the groundwater consulting fraternity, need to take the lead, under the guidance of the Department of Water and Sanitation and its strengthened groundwater component."

The problem appears to be twofold: inadequate aquifer management planning, and inadequate government support mechanisms.

4.1.3. Monitoring: active, accountable monitors

Ostrom (1990) stresses that even if users come together and formulate good rules, it does not mean that they will abide by them. Ostrom found that "reputation and shared norms are insufficient by themselves to produce stable cooperative behavior over the long run" (Ostrom, 1990:93-94). Ostrom's (1990) iteration of this principle is that there are monitors of user actions and resource conditions, and that these monitors are accountable. Cox et al. (2010) divide this principle into two sub-principles: 4A "Monitors are present and actively audit CPR conditions and appropriator behavior" and 4B "Monitors are accountable to or are the appropriators". Cox et al. (2010) found that the statistical support for 4A was moderate, but the evidence for 4B was very strong. They found that monitoring was often a result of other rules and methods for resource management and so was sometimes not expensive. In other cases, monitoring happened through separate mechanisms, or by establishing paid positions for the role (guards). Either way, monitor accountability is critical.

DWS and the CMAs are the legislated monitors of groundwater resources. Most of the literature notes the lack of a monitoring network as a significant weakness for groundwater governance. DWS is working on a National Groundwater Information System (Braune et al., 2014:32). The National Groundwater Archive is the updated National Groundwater Database which records boreholes (over 250 000 boreholes are recorded on this database) (Braune et al., 2014:34). In the new system, users can upload their monitoring data (Braune et al., 2014:35). To enable effective governance and local participation, DWS recognises the need for information management (Braune et al., 2014:36). With decentralised management and more and more stakeholders involved, a central information system is crucial.

National groundwater level monitoring stations are scattered unevenly around the country, and some areas are very far from the closest station: "Investment into groundwater monitoring is about 15% of that for the surface water network" and "The regional level monitoring, presently undertaken by DWS regions, depends completely on individual regions' priority and capacity" (Braune et al., 2014:37).

There is also a serious lack of accountability on the part of DWS and CMAs who do not have the capacity to monitor. It should be noted that transparency issues around monitoring within the DWS were raised in the 2016 DWS Budget Vote debate. It appears that the DWS has not been transparent in releasing monitoring information called the Blue Drop and Green Drop reports, where municipalities self-rate their water quality

and wastewater quality and submit to DWS. It appears that a Promotion of Access to Information Act (PAIA) application was made for the DWS to release the information. This is certainly an indication of transparency issues within government (PMG, 2016). The Democratic Alliance Shadow Deputy Minister of Water and Sanitation, Leon Basson, said that the department has not complied with Monitoring and Enforcement, that the Minister of DWS had hired employees for only 85 of the 177 related posts, and that "No officials have yet been designated as Environmental Management Inspectors in terms of the National Environmental Management Act" (PMG, 2016).

The question is: How do you monitor groundwater abstraction which occurs on private property and can very easily be hidden by pumping at night or pumping beyond the abstracted amount? Ostrom's (1990) research suggests that local collective rule making has the potential to gain buy-in from stakeholders who then might self-police their actions and those of their neighbours.

4.1.4. Graduated sanctions

Ostrom's fifth principle is that "Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, officials accountable to these appropriators, or both" (Ostrom, 1990:94). Theesfeld (2010:137) suggests that the requirements and related costs of monitoring make voluntary compliance a central requirement for a governance system. This must be complimented with what Ostrom (1990) calls "graduated sanctions" within resource communities.

Ostrom's argument is that the core problems of commons management (monitoring and commitment) can be successfully addressed when resource users create operational rules that they police. Tools to police these rules include monitoring and graduated sanctions. Cox et al. (2010) found that the evidence for this principle was moderate and offers a criticism, which is linked to the criticism of principle 1 A and B. Some research has suggested that, where there is social capital, sanctions are not necessary and can do more harm than good. This criticism links to the idea that local context with regard to culture, ideology and traditions are significant factors. The importance of social norms, existing traditions and modes of action cannot be ignored and governance provisions must take these factors into account (Theesfeld, 2010:138). The relevant dimensions to this point will be discussed in the next chapter with regard to the South African social context.

DWS has low capacity to monitor user compliance regarding the licence requirements and use allocations, and thus low capacity to sanction offenders (Braune et al., 2014:27). Where users do submit monitoring information, the regional DWS does not have the capacity to verify this. The lack of centralised state capacity to verify monitoring data is a significant challenge for top-down resource governance, but might suggest that, through the development of successful local institutions and rules for management, groundwater monitoring in South Africa could benefit from increased local user participation.

Ostrom certainly emphasises the centrality of this mechanism to successful institutions. She says that robust institutions have sanctions that are enforced by themselves and not by central authorities outside of the institution. Interestingly, Ostrom makes the point that monitoring costs are related to the rules chosen, and good, coherent and inventive rules can reduce the costs of monitoring significantly, especially when the rules, such as resource rotation, have the monitors in contact (Ostrom, 1990:96).

Ostrom says, "Even though it is frequently presumed that participants will not spend the time and effort to monitor and sanction each other's performances, substantial evidence has been presented that they do both in these settings" (Ostrom, 1990:94). She draws on Margaret Levi's concept of "quasi-voluntary compliance", because the resource users comply voluntarily, but the possibility of sanctions acts as coercion to cooperate (Ostrom, 1990:94). This compliance is contingent due to the nature of collective action where interactions between users are recurrent. The sanctions and enforcement increase perceptions that other users will abide by the rules, thus increasing the perceived likelihood that participation will lead to benefit. It seems that resource users can perceive benefit in giving their time to monitor others, as this provides information on the levels of compliance which the user can draw on in his/her strategic decision-making, and in redefining the rules to reduce the possibilities for rule-breaking behaviours observed (Ostrom, 1990:97). This is a fascinating finding because it challenges previous assumptions about the willingness of resource users to invest time and effort in monitoring, and may suggest a greater role for user-driven monitoring in South Africa.

4.1.5. Conflict-resolution mechanisms

Ostrom's sixth principle is that "Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials" (Ostrom, 1990:100). These mechanisms can be formal or

informal. Ostrom does note that, even with simple rules, there can be ambiguity over what is an infraction (1990:101). The results of the Cox et al. (2010) study show that the principle tested with moderate strength. This confirms that management does seem to be more challenging without these mechanisms. While there is the option of taking complaints to the Water Tribunal, this is a higher-level mechanism. Local government is not a capacitated conflict-resolution actor in many areas, and might even be an actor in situations of conflict in its position as a user groundwater. DWS has been known to act as mediator in the development of Catchment Management Strategies between stakeholders with conflicting interests. The lack of local conflict-resolution mechanisms is potentially a gap that DWS should take into consideration.

4.1.6. Government support to local decision-making

Principle 7 states that: "The rights of appropriators to devise their own institutions are not challenged by external governmental authorities" (Ostrom, 1990:101). This requires that the officials at a minimum accept that the rules are legitimate and that local officials accept that resource users share authority to make rules (Ostrom, 1990:101). There are many examples of states instituting rules that are inappropriate for the local situation and which end in dysfunction (Cox et al., 2010). If local knowledge is not recognised and existing institutions are ignored, then local government management can fail.

In South Africa, the legislated provisions for the establishment of WUAs, as well as the NGS (2016) Draft 4 document's focus on enabling and supporting the development of local management institutions, are evidence that at a national level there is government support for local management. That said, the legislated nature of WUAs, and the requirement that the DWS minister approves the WUA business plan for the institution to be established, can be seen to impede or reduce the 'rights' or freedom of stakeholders to devise institutions. The requirement that WUAs include the relevant stakeholders in the area, and that the business plan include instruments for capacity building of previously disadvantaged stakeholders, was DWS's attempt to ensure equity and inclusion in local institutions. This has led to challenges to and blockages of the establishment of these institutions. The primary challenges seem to point to issues of financial and state support of the implementation of these institutions. At the local level, the mindset of municipal government towards groundwater management sustains low levels of engagement and planning of municipal officials in groundwater governance.

Interesting questions arise about the methods which government can use to facilitate learning and capacity development of local groundwater users – private users as well as

municipalities. DWS strategic actions, noted in the NGS Draft 4, include conducting a capacity gap analysis to build capacity, with DWS taking a leading role. Also noted is the intention to establish a framework focused on capacity building at the technical and vocational education college level, focused on training for the water sector (Department of Water and Sanitation, 2016:83). These actions would seem to support local decision-making.

4.1.7. Governance

Principle 8 "Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises" (Ostrom, 1990:101). Interestingly, Ostrom says that all of the cases of successful institutions that she studied entailed nested levels of activities. Challenges vary across different levels, and a variety of rules are needed for sustainability across the levels.

Cox et al. (2010) support this principle. There are many instances where nested systems are important, especially where the resource extends across social institutional boundaries, (e.g., across local municipalities, or involving multiple scales of government). This is the case in South Africa where aquifers cross administrative boundaries. Nesting of institutions can help to bring together user and resource boundaries, to ensure that they correlate. Cross-scale linkages are sometimes essential. The nesting can be between levels of user groups or between users and government levels. Nesting between users and government levels is called co-management (Berkes & Folke (eds.), 1998). Cox et al. (2010) mention that Ostrom seemed to be referring to vertical nesting, but that they include horizontal nesting in their conception of this principle.

Water policy in South Africa specifically aims to prevent the federalisation of river basins and the institutional arrangements aim to enable a layered governance approach. Resource management functions are split across levels, which require cooperative governance as well as effective implementation of decentralised management institutions and regulations. The implementation and 'joined-up' management has been a slow process. Despite this, the DWS's emphasis on moving towards a layered governance system with devolved decision-making powers is promising, in that it seems, from Ostrom's (1990) research, to be highly supportive of local institutional success.

In conclusion, this initial analysis does seem to highlight and reiterate the literature consensus on a few key challenges to local institutional development in South Africa.

With regard to user boundaries and resource boundaries, the basic framework exists, and what is required to strengthen this is the increased data updating and dissemination of abstraction and mapping data to groundwater stakeholders, as well as monitoring of resource use to increase the perception of benefits to collective action.

Despite the existence of few functioning local institutions for groundwater management in South Africa, Ostrom's (1990) principles do point to some widely recognised challenges:

- Collective agreement on appropriation and provision rules is necessary; it can be seen that, based on the literature on the implementation of groundwater governance, government can support this by supporting the development of aquifer management plans by all stakeholders.
- Ensuring equitable and inclusive participation in rule making is essential, and the DWS should adapt their approach based on the challenges evident in WUA implementation.
- Local conflict-resolution mechanisms are especially important and present as a significant gap in the South African governance landscape, as does the need for monitoring of water use.
- In order to tip the perception balance so that stakeholders are more likely to perceive benefits of interaction and cooperation, the DWS will have to use innovative instruments to both incentivise participation (through either ensuring the distribution of funding or the direct funding of monitoring activities as the first step towards the development of clear aquifer management plans), and through reducing barriers to participation.

4.2. What are the limits to using Ostrom's (1990) principles to understand South Africa's local groundwater governance challenges?

The analysis so far shows that the aspects, which Ostrom highlights as being centrally linked to successful institutions, do reflect some of the challenges widely recognised in the literature. These challenges are lack of effective monitoring, collective rule-making opportunities, issues of ensuring inclusivity and increasing the perception that stakeholder actions will yield positive results.

There are, however, clear limits to the depth of understanding which can be developed. Ostrom's principles of effective local institutions for CPR management are just that – they are aspects of institutions. This focus on the institution is very helpful for developing countries looking to invest in and build a more proactive, engaged and participatory resource governance system at the local level. It is evident, from the implementation analysis literature, that government attempts to build local participation into its resource governance regime have met challenges along the way; these undoubtedly pose difficulties for the implementation of the NGS (2016) which is currently under development. Understanding the challenges in South Africa, however, requires that we look beyond Ostrom's focus on the institutional level to the socio-economic and political. Individual interactive capabilities and socio-economic divisions in society are features of the South African landscape. While Ostrom does mention that social homogeneity reduces barriers to the development of trust, this important point is not elaborated on.

In a sense, Ostrom's principles (1990) are indeed a robust outline of the features of successful institutions, thus have been helpful in guiding analysis. In another sense, much more research is needed to explain more fully the reasons why Ostrom has found these results, and what role other variables have in reducing the likelihood for a collective organisation. This requires a theory of the commons, which we do not yet have.

Certain key barriers to local institutional development are evident in the literature on groundwater governance in South Africa. The social and political realities are not included as variables in the detailing of her principles. Ostrom's research shows that it is essential that government recognises the right of resource users to organise and create their own rules, but she does not unpack the degree to which historical socio-economic realities, and the form of state support, can create barriers to the success of institutions – even within a political system committed to decentralised governance. It is these two areas that seem especially relevant to the intricacies of building participatory groundwater governance in South Africa. It is also these two factors that seem the most challenging to address.

Issues of inequality and marginalisation, the impact of social homogeneity, low education levels, the role of tradition and social capital, as well as the role and methods of support by government, will be discussed in this section as key 'gaps' in using

Ostrom's principles to understand the challenges to participation in groundwater governance in South Africa. It is important to look beyond aspects of successful institutions towards seeking innovative responses to the central social and political challenges in a post-colonial country like South Africa.

This section will discuss the centrality of questions of the social dynamics related to inequality and marginalisation to understanding the challenges to local participation in institution building. The next section will discuss the form and role of government in guiding and facilitating local institutional development, by creating an enabling environment for the strengthening of Ostrom's principles. The aim is to better understand the complex situation where a historically centralised government department such as DWS aims to decentralise and democratise resource governance in the context of particular education and capacity challenges at the local level across the country. It is suggested here that these two dynamics, of the social and political landscape, must be understood to ensure that the practical policy and regulations, which come out of the process of governance strategy development, are reflective of the realities on the ground. Even more crucially, the strategy followed must be incremental and in line with existing policy.

It is evident from the commons literature that governance systems are very difficult to establish, as combinations of policies and institutions can produce varied results in differing contexts. Actions occur in contexts with existing rules and norms, which can be impediments to change. Ostrom's principles are broad aspects of successful institutions and so, understandably, do not help us to understand barriers that are socio-political, economic, historical and contextual. That said, her principles do help us to identify in the South African context what aspects of successful institutions are significantly challenging to address, considering the conflicting and connecting inequalities that seem to be significant barriers to local institutional development for groundwater stakeholders in South Africa.

4.2.1. Inequality and marginalistion

Ostrom discusses, in *Governing the Commons,* that the fewer variables there are that divide people, such as inequalities of wealth, asset ownership, skills or information, and the less group differentiation, such as through ethnicity or race, the fewer barriers there are to collaboration (Ostrom, 1990:89). That said, she has been critiqued for dismissing this context in the formulation of her principles. Agrawal (2001) argues that the context

of heterogeneity and poverty is missing from Ostrom's principles, that she does not show how heterogeneity affects common action. Resource users tend to be very different, with various "ethnicity, gender, religion, wealth, and caste", yet "empirical evidence on how heterogeneities affect collective action is still highly ambiguous" (Agrawal, 2001:1657). Even where the users have similar backgrounds, it is clear that the likelihood is that users who have more wealth and/or resources will get higher pay-offs (Agrawal, 2001). In South Africa, the history of inequality and unequal accumulation of wealth creates many intersecting and converging difficulties for collective action for institutional development.

4.2.1.1. Unequal social capital

Ostrom has been critiqued with regard to the principle 1A of user boundaries. Ostrom has not explained why user boundaries are important sufficiently. Cox et al. (2010) show that the significance of user boundaries may lie in an unseen aspect of the local condition or from "bureaucratic imposition", rather than from the identification of who may or may not use the resource. Existing traditions or socio-economic similarities may account for the significance of defined user boundaries as aspects of successful institutions. The critique implies that Ostrom's principle is not sufficiently clear or comprehensive enough regarding the causation behind why user boundaries seem evident in many successful and enduring commons management institutions.

Those who have critiqued Ostrom's first principle of user boundaries for not establishing the causal link between user boundaries and successful institutions suggest that this principle could be indicative of other factors such as social capital, shared norms and community heterogeneity. Ostrom draws extensively on game theory to explain why user boundaries seem to be significantly tied to success. She says that game theory helps people to see that the establishment of user boundaries adds to the assurance that the individual will receive proportional benefits from their participation, and that unknown others will not benefit undeservedly (Ostrom, 1990:91). This assurance makes participation more attractive and less uncertain for stakeholders. This makes sense, but in post-colonial countries such as South Africa, this link is complex due to other factors such as social divisions that may reduce the power of this variable in contributing to the success of local institutions.

When it comes to the initial step of organising for institutional development, it makes sense that defining who does and does not have a role to play is necessary to enable collective action. There is a deeper question to pose here: If the resource users are

identified as stakeholders and their use is documented through the registered database, how do existing inequalities affect the perception of proportional benefits which stakeholders might have? In other words, even when users are identified, do inequalities affect the assurance benefits gained from this identification, as these benefits rely on perceptions of interactions leading to proportional benefits? In South Africa, it does seem to be the case that inequalities have a negative effect on the likelihood of successful organisation. The implication may be that this likewise suggests implications for the explanatory power of this principle, in line with critiques already leveled against this principle.

4.2.1.2. (un)Shared norms

Ostrom (1990) suggested that the likelihood of collective action and cooperation is increased with small groups of homogeneous people who interact fairly often. Ostrom has been critiqued, for not paying enough attention to conceptualising what she means by 'local conditions' (principle 2A). It has been argued that the lack of the inclusion of relevant variables such as local culture, traditions, ideologies and methods of sustaining livelihoods is a problem, as these variables have significant impacts on strategies for and challenges to collective action (Morrow & Hull, 1996; Young, 2002).

Ostrom has been accused of only partially explaining institutional success, because the principles focus on institutional characteristics and neglect to factor in the importance of social aspects such as transparency, trust and legitimacy, which have significant effects on institutional sustainability (Harkes, 2006:250-251). Inequalities do seem to affect the perceptions of the likelihood that the benefits of collective organisation in rule making will be proportional. Ostrom explains that individuals make decisions informed by rational processes of cost/benefit analysis, as well as by the existing behavioural norms and related values of their community (Ostrom, 1990:35). Shared norms enable collaborative decision-making. Where there are low levels of shared norms, then collaboration is constrained by the expectations that others may be opportunistic. Ostrom says, "In such a setting it is difficult to develop stable, long-term commitments" (Ostrom, 1990:36). Shared norms can be seen as social capital that plays a crucial role in enabling monitoring and sanctioning, by reducing the need for intensive surveillance of user actions (Ostrom, 1990:36). Some examples of participation norms include the understanding that regular meeting attendance is important, norms of how knowledge is communicated and how conflict is resolved. The capability of resource users to collaborate can be reduced if communication between users is difficult, if trust is not

easy to build, and if there is no shared vision of the future of the resource (Ostrom, 1990:21).

In South Africa, farmer attitudes and traditions have been developed over decades, with the established white commercial farmers having traditions of cooperation that date back to the early 1900s (Knüppe, 2011:71). On the other hand, over the same period of time, black farmers have been disempowered and excluded from engaging in established networks. Changing farmer attitudes and customs regarding groundwater, which have been embedded in decades of tradition, will take time. Attitudes will need to change in two ways: becoming more open to collaboration and cooperation between different social groups with distinctive languages, customs and histories, as well as adapting to new methods of managing groundwater as a public resource rather than a private one.

Adjusting to the uneven focus on surface water in the technical training of engineers is also key and will take time and political will to correct. Ostrom's approach has been recognised for enhancing our knowledge on the relations of social and resource systems, but has been critiqued as being too objectivist and for framing the aspects a-historically (Mosse, 1997; Cleaver, 2000). Agrawal's primary critique relates to Ostrom's focus on institutions: that she overlooks the importance of the larger "social, physical, and institutional environment" and the causal relationship they may have on institutional sustainability (Agrawal, 2001:1651). This includes demographic and market-related issues, power relations and technological adaption (Agrawal, 2001:1655-1656). Agrawal argues that an understanding of the impact of "specific histories of concrete societies, and explicit incorporation of cultural and political factors" is crucial (Agrawal, 2001:1653).

4.2.1.3. Perceptions of the lack of transformation

A second point relates to perceptions that the benefits from collective action will be proportional. Historical inequalities over access to water resources and access to state funding for the development of water infrastructure and irrigation, together with the lack of transformation and redistribution of water allocations, create barriers to collective action. Resource users such as emergent farmers and previously disadvantaged water users still feel that significant redress and transformation has not occurred. This is important because it has implications for the perceived legitimacy of the user boundaries and the perceptions of what 'proportional benefits' means in terms of transformation and redress.

Ostrom's principles of effective institutions arguably do not pay enough attention to this aspect of the groundwater governance challenge. In South Africa, systemic inequalities have continued, and inequalities have been inherited from apartheid. While water user boundaries are clearly defined through the water use authorisation process, a lack of transformation and the continuation of historic inequalities in access to water blur the legitimacy of the authorisations (at the level of user perceptions). The contestation over government authorisations creates a situation of unique societal challenges where, at a policy level, the provisions are sufficiently enabling of local management, but, at the ground level, perceptions of inequality and a lack of sufficient transformation can reduce the perceived legitimacy of the user boundaries. This can and does lead to contestations over equitable divisions of provision responsibilities and costs, and has implications for the likelihood of success of local institutions. The NWA (Republic of South Africa, 1998a) protects existing water use, and water licence applications take into consideration investments already made in water infrastructure. This clearly advantages existing large-scale commercial water users.

In South Africa, user boundaries are legitimated by the state water use licensing process, but are also areas of contention. This dynamic poses a challenge to collective action. While the boundaries of who can and who cannot use the resource are clear and formally legitimated, the lack of real transformation and related agitated social dynamics may still pose a challenge to collective action. Does this indicate a weakness in the principle? Is the issue of a conceptual nature? The nature of Ostrom's principles is that they do not encompass all contingencies, and are reflections of generalities of successful institutions. Can user boundaries be both legitimate and contentious? Ostrom is looking at self-established institutions where users have more autonomy to make decisions over user boundaries. In South Africa, there is less flexibility, due to the centralisation of the water use licensing process and due to the protection of prior existing use. Perceptions that redress has not taken place can create barriers to collective rule making, where agreements over responsibility and financial burden-sharing must be made.

4.2.1.4. Education

A report for the WRC on surface and groundwater governance provisions suggested that the WUA institutional model is not likely to be successful in settings where stakeholder capacities are low (Riemann et al., 2016). The lack of financial, technical and organisational capabilities are part of the reason why some irrigation boards have not

yet converted to WUAs, and why previously disadvantaged resource users have not widely adopted WUAs as institutions for water management (Riemann et al., 2016).

Ostrom's indication that successful institutions are ones where "most individuals affected by the operational rules can participate in modifying the operational rules" corresponds with the intention of DWS water policy to enable local level management. Issues of exclusion from decision-making were addressed through the legislation of WUAs for local participation. Yet, even within these collective choice institutions, there are barriers to participation and exclusion continues. The challenges of the WUA institutions are indicative of wider societal issues stemming from the lack of transformation since apartheid. The lack of inclusion of indigenous knowledges, the low quality of basic education, as well as insufficient technical and vocational education and training leading to skills such as management, administration, and business planning, reduces the likelihood of the successful participation of previously marginalised individuals. This creates difficulties for collective action at the local level. These difficulties of capacity are compounded by serious power imbalances.

4.2.1.5. Political-economy inequalities

On the question of the balance of benefits and costs from the use of groundwater, Ostrom's principles do not advance understanding of the challenges implicit in this evaluation where the local social political context is complex. In South Africa, historic inequalities continue and established farmers must work together with emergent farmers who do not have the same capacities for business, administrative and resource investment that the established farmers have. The resources of established farmers (financial, legal, human capacity) make them more powerful thus the "Institutional arrangements in irrigation scheme management must also be tailor-made to take into account the low literacy levels among smallholder farmers" (Muchara, Ortmann, & Wale et al., 2014:707). Agrawal suggests that where the political context is one of racial inequalities, then sustainability may be increased if the arrangements are less based on equality, are less "fair", and perhaps more attuned to principles of equity (Agrawal, 2001:1660).

> "As another example, consider the question of fairness in allocation of benefits from the commons. Typically, intuition as well as much of the scholarship on the commons suggests that fairer allocation of benefits is likely to lead to more sustainable institutional arrangements. But in a social context

> characterized by highly hierarchical social and political organization, institutional arrangements specifying asymmetric distribution of benefits may be more sustainable even if they are entirely unfair. The caste system and racial inequalities constitute two familiar examples of such hierarchical social arrangements" (Agrawal, 2001:1660).

Political economy factors such as unequal power relations (due to existing exclusionary informal networks between established farmers), and unequal access to resources, finance and information, can influence decision-making at the local level significantly, greatly reducing the likelihood of trust building. The agricultural and social landscape being partly occupied by well-resourced rent-seeking farmers and previously marginalised emergent farmers means that, in some cases, deliberative decision-making will involve navigation through many related and divergent issues and conflicting perceptions. These can be a challenge to local institutional development that is related to the history and politics of the South African context.

Cox et al. (2010) make it clear that political economy factors may distort our understanding of the dynamics at play in various case studies. Situations may look as if mechanisms for collective choice are successful but, in reality, powerful local users, administrators or bureaucrats from central government might significantly affect the decisions taken. This is not always evident to the analyst. The literature reflects this reality: "Significant research on the effects of development projects and also on commons suggests that better-off group members are often likely to gain a larger share of benefits from a resource" (Agrawal, 2001:1658). Actors seeking personal benefit can prevent collaboration in developing collective rules where there is inequality in access to power, resources and influence. In this kind of situation, Ostrom suggests that they may require assistance from outside, from government or a third party (Ostrom, 1990:21).

Gbetibouo (2009) studied farmers in the Limpopo Basin and revealed that, with regard to adaption to climate change, the primary barriers to adaption perceived by the farmers were "poverty, lack of access to credit, and lack of savings" as well as "insecure property rights and lack of markets". Some farmers also noted that information deficits factored (Gbetibouo, 2009). Gbetibouo suggests that, "Given that lack of financial resources is one of the major constraints to adaptation, access to credit enables farmers

with limited financial resources to purchase the necessary inputs and equipment associated with many adaptation options" (Gbetibouo, 2009).

4.2.2. Form and role of government

It is clear that government prioritisation, capacity, as well as transparency is required to alter the status quo (Theesfeld, 2010:139).

4.2.2.1. Form of government: centralisation of power

In South Africa, the intention of government is to enable local management and so, at the level of policy, the intent is for WUAs to enable "the rights of appropriators to devise their own institutions". The WUA structure, however, is heavily structured by policy, so there are significant boundaries placed on how stakeholders organise, which results in some challenges to local autonomy "by external governmental authorities". The WUA policy has not been historically targeted towards groundwater resources management, but has been rolled out on the basis that irrigation boards be transformed into WUAs. The establishment procedures require the development of business plans and the minister must approve these for the WUA to be established. This was structured by government to ensure representivity within WUAs, as business plans require inclusion and consultation with all stakeholders as well as plans for capacity building. The intent was to ensure that stakeholders are not excluded from these institutions, but has created administrative barriers to their establishment (as discussed in Chapter 3).

DWS has positioned itself as a facilitator of water resource management in South Africa and the WUAs and CMAs are legislated instruments to enable decentralised management and institutional development. The extent to which real decision-making power has been decentralised is debatable. The continued centralisation of power in South Africa makes cooperation difficult, and coordination and integration is poor. Knüppe (2011:72) says of the situation in South Africa that:

> "The involvement of stakeholders in decision-making processes and resource utilisation is mostly weak and barely acknowledged by groundwater managers and government agents. The movement towards 'bottom-up' approaches is crucial for the success of sustainable groundwater management but has received hardly any recognition in South Africa**".**

There is a clear disconnect between DWS policy intent to enable decentralised management, and the ability of the legislated instruments to bring about this change.

The continued centralism of power and the lack of stakeholder and government capacity at the local level create a dilemma for local management. Where stakeholders attempt to organise, the legislated facilitative instruments are not adequately enabling, and can be cumbersome and even act as barriers. In other situations across the country, local institutional development may not be likely at all and the lack of direct government intervention and facilitation of conflict resolution means that unsustainable resource use continues unabated.

4.2.2.2. Barriers for decentralised institutions

Ostrom's lack of focus on the social, historical and institutional barriers such as capacity creates a gap. Where there is low government involvement and regulation, people have more freedom to develop institutions that suit their circumstances. In South Africa, water resource use applications, management regulations, and even funding assistance procedures place requirements on individuals that can be seen to place barriers on the ease with which they can organise. WUA business plan requirements, grant applications and licence applications all require and presume a level of basic education, which is not necessarily held by resource-poor farmers and other stakeholders. It is crucial at this point to make it clear that all people, regardless of education level or resource wealth, are capable of agency and innovation. The WUA structure, which can be administratively complex to establish as it requires business experience and literacy capabilities, can create barriers and disincentives to organisation for stakeholders without this background (Riemann et al., 2016:53).

Municipalities responsible for managing groundwater resources have been struggling to do so effectively. Inadequate infrastructure operation and management, poor maintenance of municipal well fields, and a lack of water expertise within municipalities hinder groundwater governance (Department of Water and Sanitation, 2010). Local governments in South Africa, which advertise technical staff positions, tend to struggle to fill the positions, due to both the shortage of expertise in the labour market and the unwillingness of skilled personnel to relocate to rural areas. Pietersen et al. (2011:30) note that, of the 231 local municipalities, 74 do not have technical personnel employed.

The lack of financial capacity at local level suggests that, for effective local conflict resolution, the facilitation role should ideally be held by local government. The hydrogeological capacity in the country is low, as socio-economic and resource data, as well as human expertise, are lacking. At national, regional and local levels there is a serious need to develop human expertise in groundwater. At the national and regional

level, there is no groundwater director/leader and, at local level, technical skills are essential but missing. Knüppe (2011) suggests the need for a coordinator of groundwater. Monitoring data is insufficient and the NGD requires updating. The coordination between government levels and the horizontal linkages between sectors require improvement. Knüppe's (2011) findings suggest that one of the key challenges to groundwater governance in South Africa is that the importance of groundwater is not widely understood by local governments. Groundwater is resorted to primarily to combat drought, rather than as a crucial resource for managing future water demand. This perception is tied up to its previous status as privately owned and to the fact that groundwater is unseen and so unappreciated (Knüppe, 2011:71).

4.2.2.3. Role of government

The role of government support seems more integral to the success of local institutional development in South Africa than is perhaps indicated in Ostrom's conception of the enabling factors. In *Governing the Commons,* Ostrom notes that people make decisions based on a diverse set of variables. The extent to which the users have reliable information about the resource, and the social norms and notions of reciprocity in existence in the group, are significant factors (Ostrom, 1990:210). Collective decision-making to reduce the incentive to shirk responsibility is a difficult task: "It is essential to consider not only the variables that characterise a particular CPR situation, but also the type of external political regime under which the CPR is operated" (Ostrom, 1990:211). Ostrom argues that there is a role for the political regime in enabling collective-choice rules if it "allows substantial local autonomy, invests in enforcement agencies, and provides generalised institutional-choice and conflict-resolution arenas", as well as providing information services and funding mechanisms (Ostrom, 1990:212).

Although Ostrom speaks to this theme, Agrawal argues that she pays insufficient attention to the role of political variables, such as government policies and governance systems, in the success of local institutions. Agrawal (2001) argues that Ostrom effectively overlooks the role of state policies and governance arrangements by not including them as variables (Agrawal, 2001:1657-1658). This does not necessarily suggest a flaw in Ostrom's research, but rather a lack of clarity, which points to the existing consensus in the commons literature: that one size does not fit all and, in some cases, government assistance is essential to move things forward, while, in others, it may not be necessary at all. In situations where water demand is high and many users share the resource, the likelihood of resource users not organising collectively and

depleting the resource is higher. Ostrom says,

> "If there are substantial numbers of potential appropriators and the demand for the resource units is high, the destructive potential should all be allowed to freely withdraw units from the CPR could push the discount rate used by appropriators toward 100%. The higher the discount rate, the closer the situation is to that of a one-shot dilemma in which the dominant strategy of all participants is to overuse the CPR" (Ostrom 1990:91).

What is the significance of this for South African groundwater use, considering impediments to local institutional development, and considering the need in some contexts for direct government intervention? What is the significance considering the current drought? Perhaps this suggests that the likelihood of collective organisation is less when there is existing stress on the resource such as in mismanaged systems, and in drought conditions, when the resource quantity and/ or quality is reducing. Yet, it has also been suggested that it is in situations where resources are seen to be seriously at risk that people are driven to engage to bring about change.

Ostrom (1990) recognises that local collective management is not always feasible and, depending on the context, external government top-down action may be needed. In a country where groundwater resources have not been managed effectively in the past, the prior existing rules in use impact on the possibility for future collective action. Ostrom's argument here resonates especially loudly when thinking of the history of groundwater in South Africa. Perhaps the indication is that central leadership is needed to identify the cases and areas in South Africa where a more direct approach to government facilitation is required; new conceptions of the facilitative role of government are needed for the contexts where stakeholders are in processes of organising. In cases where there have been attempts at institutional development, it seems imperative that government steps in to provide assistance. Muchara et al. (2014) showed that "Irrigators who joined the local WUA revealed higher participation intensity compared to non-members, this suggests a need to increase farmer participation in formalized institutions that also expose them to water management training, through capacity-building programmes run by the government and other initiatives" (Muchara et al., 2014:707).

The essence of Ostrom's argument is that approaches to resource management need to be dynamic and that a 'one-size-fits-all' approach is not possible. The implication is that while national policy and regulations establish intent to decentralise institutional development and local management, but without success, at a bureaucratic level the capacity for distinguishing different methods and strategies for government intervention in local resource management needs to be developed.

A variety of policy instruments can be used to enable governance structures such as regulatory and economic instruments, and voluntary or advisory instruments (Theesfeld, 2010:133). Governments can use funding incentives to stimulate the collaborative organisation of users at local levels (Schleyer et al., 2006:128). A good governance system is one where transactions are coordinated, duties upheld and rights protected (Theesfeld, 2010:133). In this context, collective action, self-governance and centralised governance are all types of organised governance systems that establish different rules. In the South African context, it is evident that a mix of: direct government action to stimulate communication between stakeholders; as well as more facilitative action to embed capacity, training and resources at the local level for active stakeholders; are both needed.

Ostrom's indication of the importance of monitoring is empirically important to local management for many reasons. Without monitoring of the resource dynamics, the users could not create rules that appropriately dictate resource abstraction and provision requirements. Ostrom's use of economic and collective action theory to explain why the existence of monitoring rules influences resource user compliance is an important contribution to our understanding of what variables encourage collective action. The possibility of sanctions is a significant factor that encourages user compliance. This finding suggests the importance of monitoring, and indicates the seriousness with which we should perceive the lack of government accountability and monitoring network in South Africa. The indication is that, without the development of the monitoring network, local collective management will be significantly more difficult to establish.

Lastly, Ostrom helps us to recognise that, when it comes to 'nested enterprises', this is clearly the intention of government water policy; however, there are considerable challenges regarding the effectiveness of the instruments, the implementation and the need for diverse strategies in diverse contexts. There are challenges to installing nested enterprises from a national central government perspective. Ultimately, for

groundwater management to be adaptive and sustainable, it must be localised and correspond to the socio-economic context and the nature of the specific aquifer (Knüppe, 2011: 74). The ecological importance of groundwater is not understood with the economic value going unseen. It is important that greater significance is placed on groundwater as a strategic resource.

For resource governance to be sustainable and adaptive, the institutional arrangements must enable systemic learning through management implementation**,** i.e., 'learning by doing' (Petersen et al., 2016). In South Africa, this requires a change of structure, moving away from centralised management towards more participatory and polycentric systems (without altering or disrupting the core water policies). This entails the enabling of participation and collaboration at all levels, more decentralism and flexibility in management approaches, incentives, increased awareness of environmental needs and greater information access and monitoring (Knüppe, 2011:74). Knüppe emphasises that sustainable groundwater governance requires the organisation of people (their cultural and ethical customs) and the resource in unison, and that both aspects are equally important. Enabling cooperation and networks of users is just as essential as enhancing information on the resource dynamics (Knüppe, 2011:74). Enabling participation requires supportive government at the local municipal level, as well as at national level, where government can mobilise citizens, make funds available, focus on infrastructure, develop human resources and play a coordinating role (Knüppe, 2011:76).

Ostrom found that, if the process of establishing institutions is successful, then value is generated through subsequent incremental transformations and learning (Ostrom, 1990:190). She suggests that a central element missing from our understanding is the significance of building institutional capital as well as social capital. This is a profoundly relevant point for the South African context. Developing trust and social capital between previously separate social groups makes establishing and maintaining local institutions challenging.

With regard to the South African context, Ostrom makes another important comment**.** She says that comprehensive external authority control of CPR requires full knowledge of the resource, clear resource use authorisations, and an enforced monitoring system, but that this recommendation gives "little consideration to the cost of creating such an agency" (Ostrom, 1990:10). The DWS has been struggling to set up CMAs for years now.

These agencies are the intended central authorities for water resource management at the regional level. She says that argument for centralised control assumes "accuracy of information, monitoring capabilities, sanctioning reliability, and zero costs of administration" (Ostrom, 1990:10). When agencies lack these capabilities, or make unitary decisions, they could make mistakes which impact negatively on the resource and users. Without reliable data and context-specific information, models devised externally may not work in reality. When decisions are imposed on users, there is a greater need for external monitors to enforce the rules (Ostrom, 1990:17-18).

Ostrom's principles reveal gaps in our understanding of how inequalities and marginalisation act as impediments to the likelihood of successful local institutional development in South Africa. We look to the role of government to answer the question of how these challenges can be addressed, how governance can be strengthened, with particular focus on enabling local institutional development where it is feasible, and stimulating local engagement and communication where social, political and economic barriers are especially detrimental to resource sustainability. The potential impacts of external political regimes can enable users to organise, but they can also create difficulties and hinder user organisation. The activities of political regimes have to be consciously and actively considered, in order to understand common-pool institutional set-up. The strategies and actions of these actors create incentives and affect the perceived cost/benefit analysis that the users make. Ostrom emphasises the importance of furthering our understanding of the wider external dynamics and their consequences.

5. Conclusion

Ostrom's (1990) principles do point to many of the core challenges to participation in groundwater governance in South Africa. The need for user and resource boundaries, the importance of stakeholders being able to develop rules collaboratively, monitoring, sanctions, conflict resolution, government support, and nested governance levels are all areas which pose challenges in South Africa. In line with current legislation, policy and regulations, many of the key challenges require government action: updating groundwater information databases, increasing access to funding for groundwater assessments, supporting the establishment of the regional institutions to provide support at the local level, providing support to struggling municipalities, building groundwater technical capacity across the country and developing conflict-resolution mechanisms at the local level. These are all necessary to improve the likelihood that stakeholders and resource users will perceive there to be benefits in cooperating and

engaging in institution-building. Ostrom's principles point again and again to one very important factor: the necessity of ensuring stakeholder buy-in. The evidence of the analysis suggests that DWS must go 'back to the basics' to focus on these aspects as Ostrom shows that they stimulate to stakeholder confidence in possible benefits from collective action.

Ostrom's aspects of successful institutions illuminate the core areas that need to be strengthened, if DWS is to enable participation in local groundwater governance: support to institution building and collective rule-making, update monitoring network, provide mechanisms for conflict resolution, and drive cooperative governance between levels of the water resource management system (from DWS to CMA to local level). Yet, DWS faces challenges that Ostrom's focus on institutions does not illuminate. Ostrom does not help us to understand how the existing context of inequality and marginalisation affects the likelihood of institutional success. The literature on groundwater governance challenges in South Africa makes it clear that some of the central difficulties to institutional development at the local level are directly related to the lack of social and economic transformation. The development of trust between individuals in this context requires overtly inclusive mechanisms for cooperation and participation in rulemaking. Exclusions of previously disadvantaged and emerging black stakeholder hinder the development of trust.

Ostrom's principles include the notion that government support to local initiatives and autonomy is important for long-lasting success. Where government support is required, the 'top-down facilitation of local actions' by a 'facilitative political regime' seems to be a well-supported approach (Foster, 2006, in Braune et al., 2014:5; Theesfeld, 2010:137). How government can provide facilitation in the context of inequality and marginalisation is another question. The literature points to cross-scale co-management institutions as a potential strategy for participatory governance and increased accountability (Berkes & Folke (eds.), 1998; Berkes, 2002; Yandle, 2006; Cinner et al., 2009).

The decentralisation of power to local levels is an ongoing process that is impeded by: a lack of groundwater expertise across government levels, perceptions of groundwater as a difficult resource to manage by municipalities, and existing centralised methods of interventions, which limit the possibility for flexible local arrangements. Considering that groundwater governance is still largely centrally planned, the challenges to local

participation suggest a real need for government facilitation; it is this question of how DWS is to fulfill this developmental and facilitative role that Ostrom does not help to answer. She does, however, point us in the right direction– by emphasising that governments must recognise that, when it comes to increasing participation in groundwater governance at the local level, and facilitating local institutional development, the only way is through facilitative and flexible approaches very closely related to the specific needs of the local context.

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