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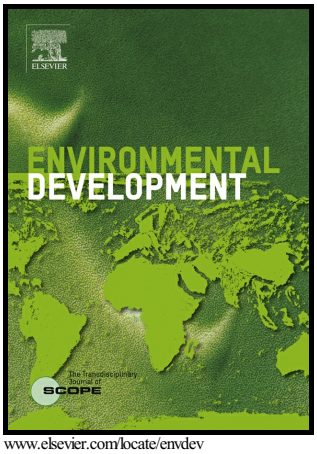

www.elsevier.com/locate/envdev

PII: S2211-4645(15)30067-1
DOI: http://dx.doi.org/10.1016/j.envdev.2016.09.002
Reference: ENVDEV304

To appear in: *Environmental Development*

Received date: 10 December 2015
Revised date: 22 August 2016
Accepted date: 7 September 2016

Cite this article as: Kathrin Knüppe and Richard Meissner, Drivers and barrier towards sustainable water and land management in the Olifants-Doorn wate management area, south Africa, *Environmental Developmen* http://dx.doi.org/10.1016/j.envdev.2016.09.002

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Drivers and barriers towards sustainable water and land management in the Olifants-Doorn Water Management Area, South Africa

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Abstract

Over the last 17 years South Africa's water and land resources management has changed dramatically. This rapid evolution has been accompanied by a growing number of laws and policies to co-balance water allocation for human basic needs and ecosystem integrity. Most often, new ideas and innovative concepts constitute new challenges towards their implementation. This paper examines drivers and barriers towards more sustainable and integrated governance and management practices from the perspective of ecosystem services in the Olifants-Doorn Water Management Area (WMA). Results obtained from a literature search and qualitative interviews indicate that the environmental awareness

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of stakeholders about their natural resources and related ecosystem services increased over the last years. Furthermore, we observed that the establishment of new polices became a key driver towards increased sustainability within the Olifants-Doorn WMA. Nonetheless, ensuring coherence between sectors and actors when considering natural resource governance remains a major challenge. For future sustainable developments, decentralized and localized management structures as well as the establishment of strong leadership should be emphasized in the Olifants-Doorn WMA. Further, sufficient water and land monitoring systems are necessary for decision makers, farmers and local water suppliers in order to maintain ecosystem services and their values for human well-being.

Key words

Ecosystem services, Water governance and management, South Africa, Olifants-Doorn Water Management Area

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1. Introduction

Freshwater and land resource systems provide important ecosystem services to humanity and can be defined as *the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life* (Daily, 1997: p3). Often ecosystem services are claimed and modified by various actors (e.g., farmers, conservationists and municipalities), which in turn produce social and ecological trade-offs because the use of some services comes at the expense of others (Bennett et al., 2009). According to Poff et al. (2003) balancing complex and often conflicting demands over water and land resources among different actors and sectors is one of the key challenges of the 21st century. To achieve a balance between conflicting demands, resource managers and environmental decision makers must integrate and negotiate competing interests from a variety of stakeholders[1], the environment included. In other words, integrated water and land management must be established to promote the coordinated development of water and land resources and related ecosystem services in such a way that socio-economic developments are assured without compromising the integrity of ecosystems (Lenton and Muller, 2009). In this paper, land management is linked to agriculture production systems such as the irrigation of crops or clearing of natural vegetation or alien invasive plants for agriculture

[1] Stakeholders are defined as any individual or group sharing common interests, and who may be affected by water and land-use decisions.

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cultivation. This means that land management for agricultural purposes should be done in such a way not to compromise future production of commodities, risks to land degradation should not increase and the quality of soil and water must be maintained for land systems to be economically feasible and socially acceptable (Bouma, 2002).

Given the mostly technocratic development trajectory of water resources (Meissner, 2015) and land management (Koning and Smaling, 2005), most management and governance systems do not provide the structural conditions necessary to implement integrated approaches without changing certain system characteristics. It is assumed that a transformation towards more sustainable practices requires (i) a shift towards participatory management and collaborative decision making, (ii) cross-sectoral cooperation and (iii) implementation of decentralized management approaches (cf. Pahl-Wostl, 2009). Although these characteristics are well known for their importance in the context of sustainable natural resources management, we strongly emphasize the relevance of further empirical investigations in order to indicate future directions of governance and management. In other words, case study research is necessary to deliver evidence-based findings including best practices as well as failed management approaches and interventions. This in turn provides the possibility for knowledge transfer to other regions of the world. In this article, water and land use management in the Olifants-Doorn Water Management Area (WMA) in South Africa is analysed. This is a typical case of a semi-arid river basin where the integrity of ecosystems is threatened by over-allocation of water resources and enduring land clearing for agriculture purposes. Prior to this research, it has been unclear if and how water and land management in the Olifants-Doorn WMA could be developed towards more sustainable and integrated practices. This knowledge gap is addressed by investigating the following research question: what are the key drivers and barriers affecting sustainable water and land management? Driving forces as well as barriers are often multiple and interacting factors such as political, biophysical, economical and societal determinants. Their causal linkages are often mediated by other factors (e.g., climate variability), thereby complicating statements of causality or attempts to establish the proportionality of various contributors (MA, 2005). A case in point is integrated water resources management in Botswana, where the country's Integrated Water Resources and Water Efficiency Plan states that poverty eradication and climate change are cross cutting issues. The Plan goes on the say that poverty eradication drives pro poor tourism and that climate change will have an impact on the country's tourism sector and opportunities in the sector (Department of Water Affairs, 2013). The link between poverty eradication, tourism and climate change is likely to be felt in the Okavango Delta, a major tourist destination in Botswana and an environment reliant on proper water and land management. Said differently, because of the plethora of variables together with their causal linkages, causality is not a simple and straightforward concept researchers

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can apply to any situation. Complexity creeps in when there are multiple variables and multiple linkages between the variables.

An intensive literature search, a policy analysis of strategic documents and qualitative expert interviews delivered enough information to better understand the regional circumstances and the main management challenges of the Olifants-Doorn WMA.

2. Theoretical and conceptual background

In order to identify and understand drivers and barriers towards sustainable water and land resources management it is crucial to understand first, the complexity of the resources being managed and second, the underlying governance and management characteristics.

2.1 Social-ecological systems and ecosystem services

Managing natural resources in a sustainable, equal and efficient manner requires integrated perspectives on social and ecological systems: a coupled, inseparable system of humans and nature (MA 2005), in which ecosystem services are conceived as a bridging component (Bennett et al., 2009). This article builds upon the definition of social-ecological systems provided by Glaser et al. (2008), under which a social-ecological system consists of a bio-geophysical unit and its associated social actors and institutions (e.g., rules and norms). A social-ecological system describes the structures and patterns of the relations between the system's elements, in which networks, feedbacks and causal chains are concepts that can be expressions of these relations and dynamics (Jahn, 2009). In this article, a river basin, the Olifants-Doorn WMA, is a social-ecological system which is described as being complex and adaptively delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context (e.g., water pollution, water scarcity, ecosystem damages).

Worldwide, the concept of ecosystem services has received attention in the sustainable management of natural resources as a way to communicate human dependence on ecological life support systems (Daily, 1997). The concept has become both a heuristic analytical tool for academics and a powerful discursive tool for conservationists and politicians interested in the preservation of nature's legacy (Fischer et al., 2009). In other words, ecosystem services as a human construction can be a theory and ideology. As a theory to manage natural resources, the concept emphasizes the critical role of integrating competing interests in environmental decision making and allows negotiating between conflicting demands over water and land resources (cf. Jewitt, 2002). A

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further advantage of this concept is to facilitate the creation of novel partnerships, particularly between civil society, the local population and corporate and governmental entities (Tallis et al., 2008). However, the concept of ecosystem services provides some challenges during the planning, implementation and monitoring phase, since this concept is not understood in the same way by all stakeholders and actors. For instance, Brock and Carpenter (2006) define ecosystem services as benefits people receive from ecosystems. For Cowling et al. (2008, p9483) ecosystem services are the 'end products of nature that benefit human' and these products can be supplied by natural and semi-natural habitats or wild nature. These definitions differ slightly, but it is a difference that can have serious ramifications when doing planning around natural resource management. If the first definition is used, it could for example exclude farm land or commercial forests, which the second definition highlights. In this article we follow the second definition.

The next section provides an overview of governance and management characteristics which are assumed to support an 'ecosystem service-thinking' approach.

2.2 Governance and management of natural resources

It is important to make a distinction between the terms governance and management. The governance of natural resources refers to the interactions among structures, processes, rules, and traditions that determine how people make decisions and share power, exercise responsibility, and ensure accountability, and how stakeholders have a say in the management [and use] of natural resources (Cundill and Fabricius, 2010). Governance and its performance is influenced by many societal actors including governmental agencies, private companies, non-governmental organizations, local communities and various interest groups (Meissner, 2015). All are influenced by institutions which are the underlying rules and structures that shape the social, economic and political transaction/behaviour within the society (North, 1990). The term management refers to analysing, monitoring, developing and implementing measures to maintain natural resources in a state that is within desirable limits (Pahl-Wostl, 2009). According to Jewitt (2002) water and land governance and management systems benefit from an ecosystem services approach as it allows society to harness the functioning of ecosystems and the services they provide.

Today, many governance and management systems are placed within a transition process from a command and control towards more integrated and adaptive resources management approaches (cf. Mehta et al., 2014). A transition is characterized by structural changes in more than one governance and management characteristic

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(e.g., from centralized to decentralized approaches) and thus involves a change in management. According to Pahl-Wostl (2015) integrated and adaptive resources management requires:

(i) institutional development, such as water and land policies, conservation measurements, agriculture reforms, resulting in the sustainable and adaptive management of water and land resources by defining roles, rights and responsibilities and guide social practices of actors (Young, 2002),

(ii) sectoral cooperation, referring to the integration and cooperation between different sectors depending on water and land resources such as agriculture, forestry, tourism, fisheries and government,

(iii) multi-level interaction, referring to the connectivity and interplay of various management levels in a hierarchical political system (from local to national levels),

(iv) stakeholder participation, referring to the broad integration of state and non-state actors including individual goals and values attributed to ecosystem services.

All four characteristics are expected to (a) contribute to improving the quality of management by incorporating different kinds of knowledge and information about water and land resources and the ecosystem services they provide, (b) increase the acceptance of decisions and innovative approaches, and (c) improve both compliance and implementation on the ground (cf. Vinke-de Kruijf et al., 2015).

3. Methodological approach

The process of data collection was based on an intensive document research (study of legal documents, publications of laws and regulations, research reports and peer reviewed articles) and qualitative interviews during field work in South Africa (March/April 2014 and November 2015). The number of interviewees included 18 participants and reflected various types of expertise and knowledge in the field of water and land resources: state authorities (at ministerial, regional and local administrative levels), consulting, water supply, agriculture, research, and nature conservation. The duration of the semi-structured interviews varied between 60 to 90 minutes. The interview questions covered (i) institutional development and change towards the integration of ecosystem services, (ii) the role of actors (state and non-state) and cooperation networks, and (iii) drivers and barriers towards more sustainable practices. Interviews were recorded and stored in *atlas.ti* which is an Aided Qualitative Data Analysis Software assisting with transcription analysis as well as coding and text interpretation (Friese, 2014). Atlas.ti allows to link findings from different media and thereby intensify the importance of

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research findings. For a structural analysis all data and information (insights from the interviews transcriptions and literature) were stored in a relational database (Microsoft Office Access software). The database is based upon the Management and Transition Framework, which is an interdisciplinary conceptual and methodological framework that serve to study the relationship between natural resources governance and management systems (here water and land systems) and their performance with regard to impacts on ecosystem services (for further explanations and application of this framework see Knieper et al., 2010; Pahl-Wostl, 2009).

4. Approaches to water and land resources management in South Africa

The semi-arid climate of South Africa and the increasing demand on water and land resources make humans, industry and the environment highly vulnerable, and change towards more sustainable management necessary (Stuart-Hill and Schulze, 2010). Moreover, urgent attention is required to correct the unequal access to water, land and related ecosystem services in order to create development opportunities for previously disadvantaged individuals and eradicate poverty (Backeberg, 2005).

Since the end of apartheid in the early 1990s, and the adoption of a democratic dispensation in 1994, South Africa went through a period of radical political and societal changes. In 1996, the Constitution of the Republic of South Africa (Act No 108 of 1996) cemented the foundation for a democratic society. Chapter 2 of the Bill of Rights states that: *everyone has the right to an environment that is not harmful to their health and well-being, to protect this environment for present and future generations, and to have access to sufficient food and water*. In this context, the water sector was overhauled and the new government published the White Paper on a National Water Policy for South Africa. In 1998 the National Water Act (Act 36 of 1998) replaced the old Water Act (Act 54 of 1956). The new Act recognizes …*that the ultimate aim of water resource management is to achieve the sustainable use of water of all users*. In this context *sustainability and equity are identified as central guiding principles in the protection, use, development, conservation, management and control of water resources* (Republic of South Africa, 1998). The National Water Act demands a transition from water management based on riparian rights and administrative boundaries towards the licensing of water use and water management along hydrological boundaries (Herrfahrdt-Pähle 2012). Here is one of the most important connections between land and water management. No longer were rights to water access linked to the ownership of land. Since most South Africans were deprived from land in the early part of the 20th Century, the new government had to divorce access to water from land ownership in order to strive for a more equitable allocation of water resources among the population. These changes also included a restructuring of the Department of Water and Sanitation (DWS,

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formerly Department of Water and Forestry later Department of Water Affairs) that became the custodian of South Africa's water resources with the adoption of the new Water Act in 1998. This Department is responsible for the formulation and implementation of policies governing this sector.

The National Water Act is regarded as one of the most progressive pieces of environmental legislation in the world (Ashton et al., 2006). It contains a vision of equity, efficiency and sustainability in the allocation and use of water, as well as ecosystem services that are derived from aquatic systems (van Wyk et al., 2006). There exists a range of innovative policies linked to the Act (e.g., the classification of water resources, ecological reserve, and resource qualitative objectives in Chapter 3 of the Water Act). These policy initiatives highlight the need to balance the protection of ecosystem services with the use of water for productive purposes (e.g., irrigation, industrial and mining uses) and by default the sustainable management of land.

The water legislation foresees the implementation of a holistic, decentralized and participatory approach to water management. The management of water is decentralized through the establishment of catchment level water management institutions, such as catchment management agencies (CMAs) (Meissner and Funke, 2014) and at a more local level, water user associations (WUAs). Public participation became a core element of water management and is a legal requirement by law. The new water policy requires stakeholders to shift away from rights-based water allocations to a system where water allocation decisions are interest-based (Dent, 2001). After 17 years following the promulgation of the new Water Act, only two CMAs out of the original 19, which were reduced to 9, are operational (Meissner and Funke, 2014), while many WUAs still struggle to find their place and role in the complex context of water management.

As land management is intrinsically linked to water, we emphasised the importance of the institutional shift in the context of South Africa's National Water Act. Land use and agricultural production shape the configuration of members' rights to land and other resources (Hall, 2009), water included. As mentioned earlier, it is this right to the access of water, contained in the Water Act, that influences land ownership and by extension agricultural production and poverty reduction. For instance, farming enterprises need to take into consideration a number of variables when developing land use plans. These variables include topography, soil types, rainfall and water availability (Hall, 2009) in close proximity (e.g., irrigation canal or groundwater reserves) to the enterprise. Without such planning, land reform and the sustainable utilisation of land is likely to be on a shaky footing, making it difficult for the farmer to produce commodities in an effective manner. Be that as it may, since South Africa's new democratic dispensation came to being in 1994 government has been implementing a land reform policy to redress inequalities in land ownership through restitution, redistribution and tenure reform. Restitution deals with those individuals or groups that had been deprived of their rights to land during the Apartheid era.

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They could lodge claims for either restoration of land ownership or financial compensation. Redistribution provided for the fostering of improved livelihood and quality of life for previously disadvantaged individuals and communities through acquiring commercial farm land (Hall and Cliffe, 2009). Tenure reform involves more complexities in explanation and we will therefore extensively quote from Hall and Cliffe (2009: 6) when they say that:

> *'Tenure reform* was seen as necessary to address what was reputedly the main problem facing the people in the former bantustans – insecure rights to land. Reforming the legal status of occupiers' rights – on state land, on communal land and on privately owned land – was a core element of the White Paper on South African Land Policy, which aimed to '*develop the mechanisms for "upgrading" de facto vested interests in land into legally enforceable rights'* and to ensure *'protection for occupants of privately owned land*' (DLA 1997: 60, original emphasis cited by Hall and Cliffe, 2009: 6). Various laws have been enacted to this end, yet reforming tenure relations has been the least developed of the three programmes of land reform. The primary dimensions of tenure reform have been provisions to specify and protect the rights of people occupying communal land nominally owned by the state, and residents of privately owned commercial farmland. After long deliberations, the Communal Land Rights Act 11 of 2004 was promulgated, but remains unimplemented and controversial. As the communal tenure issue falls outside the specific focus of this project, little further will be said about its progress and impact. However, the security of tenure of those dwelling on commercial farms, which has been addressed by other legislation, has been the subject of extensive review and debate' (original emphasis).

What these statements indicate is that land reform had been an ongoing policy concern of the new government since 1994. We can, therefore, safely say that water and land reform, as well as the management of the two resources, shifted significantly since 1994. However, the current transformation process of South Africa's water and land management poses many challenges towards efficient and sustainable implementation of the water and land reforms. The Olifants-Doorn WMA was chosen to indicate the drivers and barriers (that need to be overcome) towards more sustainable water and land management.

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4.1 The Olifants-Doorn WMA

The Olifants-Doorn WMA is located on the west coast of South Africa (see figure 1), comprising the Olifants (upper and lower part), Doring, Sandveld, Kouebokkeveld and Knersvlake sub-areas, and covers a total area of 56 446km² (DWA, 2006). The south-western part falls within the Western Cape Province, and the north-eastern section falls within the Northern Cape Province. Climatic conditions contrast considerably within the WMA as a result of the varying topography. Winter minimum temperatures in July range between -3 °C to 3 °C and

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summer maximum temperatures in January range between 39 °C to 44°C. The WMA lies within the winter rainfall region and mean annual precipitation varies between 1 500 mm in the Cederberg mountains and 100 mm in the far north of the WMA. Average annual potential evaporation ranges from 1 500 mm in the south-west up to 2 200 mm in the dry northern part (DWA, 2006). The ecoregions in the Olifants-Doorn WMA are the Western and South-Western Coastal belts, the Western and Southern Folded Mountains, Nama and Greater Karoo, and Namaqua Highlands (DWA, 2006). There are many nature reserves serving as biodiversity hotspots and conservancies for tourism and recreation aspects (e.g., Tankwa Karoo National Park, Matjiesrivier Nature Reserve, Verlorenvlei RAMSAR site, and the Olifants Estuary). The Olifants-Doorn WMA contains approximately 0.25% of the national population and is the least populated WMA in the country. Around 113 000 people live in the WMA from which half of the population live in urban and peri-urban areas, and the remainder in rural areas. The area has high poverty levels and extreme dependence on agriculture and subsistence activities.

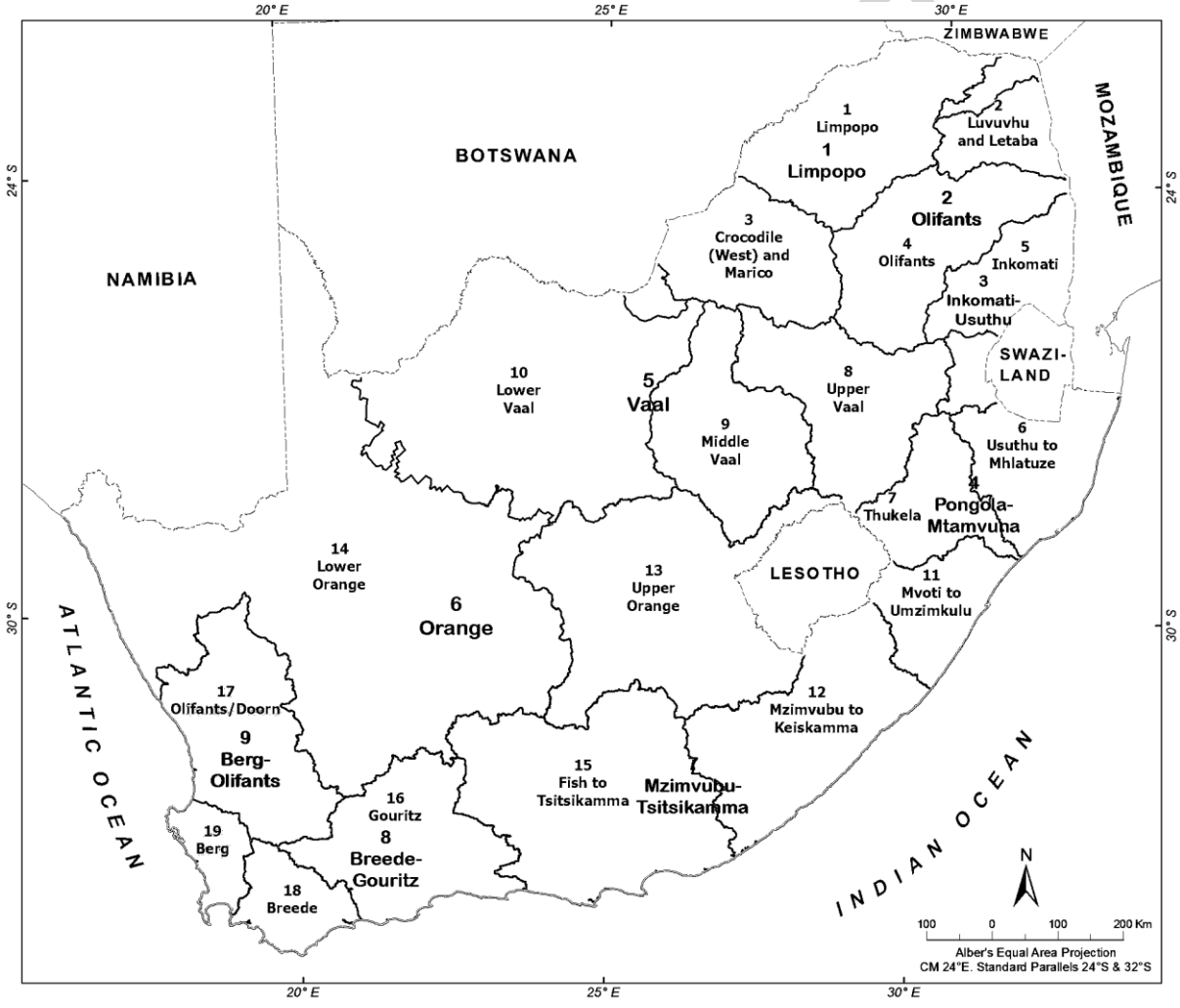

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Figure. 1. WMA areas of South Africa; the original 19 WMAs were consolidated into nine WMAs during 2012 (DWA, 2016)

Over the last 20 years water abstraction in the WMA increased due to population growth and the intensifying of agricultural practices. The agriculture sector is the most important sector in terms of job creation and development of the local economy. Commercial farmers dominate the ownership of land and previously disadvantaged farmers (both female and male including Black and Coloured people and Indians) have limited access to good quality agricultural land and water resources.

More than 90 % of the land in the WMA is used as grazing for livestock and approximately 4 % of the land is cultivated for dryland farming. Almost 500 km² of the land is required for the irrigation of citrus, deciduous fruits, grapes, and potatoes and provide the mainstay of the WMA's economy. In general, the agriculture sector uses about 95 % of the total water requirement of the WMA, which is estimated to be about 356 million m³/a (DWA, 2005).

All land use practices have impacts on water resources, either through water use, such as irrigation or water consumption in urban areas, or by discharge of runoff. These impacts include waterlogging, salination and the over-abstraction of aquifers resulting in the degradation of water resources and loss of associated ecosystem services (de Wit and Crookes 2013).

5. Results

First, the results summarize ecosystem services which are most relevant to the people in the Olifants-Doorn WMA. Second, drivers and barriers affecting sustainable water and land management are indicated.

5.1 Ecosystem services in the Olifants-Doorn WMA

From literature and expert interviews it becomes obvious that with increasing pressures from climate change as well as demographic and economic developments, competition for water and land resources increased in the Olifants-Doorn WMA over the last two decades. This in turn makes the integrated management of ecosystem services even more difficult. The list below depicts ecosystem services in the WMA which were identified by the interviewees as most relevant to the inhabitants:

1) Provisioning services -> products obtained from ecosystems
    a. Household water supply
    b. Cropping (irrigation) & livestock

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c. Fishing (rivers and wetlands)

2) Regulating and maintenance services -> benefits obtained from the regulation of ecosystem processes
    a. Water flow regulation (groundwater, wetlands, coastal)
    b. Moderation of droughts (climate adaptation)
    c. Habitat services (flora and fauna diversity enable e.g., pollination, nutrient cycling, photosynthesis)
3) Cultural and social services -> non-material benefits that people obtain from ecosystems
    a. Recreation and tourism (e.g., nature parks provide for hiking possibilities)
    b. Aesthetic beauty and heritage

For the adaptive management of land and water resources it is necessary to contextualize the differences between the above mentioned ecosystem services. For instance, at small spatial scales, provisioning as well as cultural and social ecosystem services are important for local community members, while regulating and maintaining ecosystem services are important at larger, regional or even global scales (e.g. water flow regulation).

5.2 Drivers and barriers affecting sustainable water and land management in the Olifants-Doorn WMA

Four drivers and four barriers were identified by the interviewees, which could be the rationale and momentum for sustainable water and land management. Drivers refer to changes in institutional settings, bottom-up movements, global market forces, climate change and variability and barriers refer to old and long lasting practices, adaptation to new structures, and limited capacities. While the four drivers can be assigned to context factors of the WMA, the barriers are related to factors concerning the policy implementation process. It is important to note that drivers and barriers may overlap or influence each other.

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5.2.1 Drivers

Changes in institutional settings

With the promulgation of the National Water Act, South Africa has an enlightened constitutional framework which lays the foundation for participation and good governance. It is one of the most progressive pieces of environmental legislation in the world containing a vision of equity, efficiency and sustainability in the allocation and use of water and land. The interviewees commonly agree that without these institutional changes, communities or individuals may continue to carry on with behaviours that are widely understood as harmful to

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society over the long term (e.g., over abstraction of water, clearing of natural vegetation). Although the policy implementation process in the Olifants-Doorn WMA is slow, the interviewees mentioned some positive development trends.

First, although a catchment management strategy has not been finalized for the Olifants-Doorn WMA, a draft version provides useful information for planning and decision making. Second, a *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency* was developed as required by law. The development of the Proposal was an extremely inclusive and participative process taking into account different values and knowledge of ecosystem services. Third, four WUAs are operating in the Olifants-Doorn WMA: Koue Bokkeveld, Citrusdal, Lower Olifants River, and Northern Sandveld. Insights from members of the WUAs highlighted that there are still many structural and political challenges to overcome until the WUAs can work sufficiently on a constantly and regular base. Currently, their work is basically constraint by financial restrictions and lack of knowledge exchange between the WUAs and state authorities responsible for water and land management. Fourth, the interviewees mentioned the development of the Water Resource Classification System as an important driver towards more sustainable management of ecosystem services, especially regulating and maintaining ecosystem services such as habitat services. The Classification System is a legal requirement in terms of the National Water Act (Chapter 3, Part 1, Section 2 (a)) and the primary tool for ensuring access to aquatic ecosystem services in South Africa. The Classification System for the Olifants-Doorn WMA was undertaken in order to classify all significant water resources (rivers, wetlands, lakes, estuaries, and aquifers) and to determine suitable management classes for these water resources. Some interview participants see the Classification System as the main requirement for any further development of water resources relevant for sustainable agriculture development in the WMA.

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Bottom-up movements

The interviewees identified bottom-up approaches at catchment level as one of the main drivers towards environmental awareness and negotiation of ecosystem service trade-offs across sectors. This in turn is a requirement towards sustainable water and land use practices. Since the late 1990s different programs and projects took place in the WMA. The overall goal of these local or regional initiatives was to establish collective responsibilities for water and land resources:

- *Cape Action for People and the Environment* (CAPE) is an ecoregion-based conservation initiative and is coordinated through the South African National Biodiversity Institute and its Fynbos Program.

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- *Biodiversity Stewardship Program* was established to secure priority biodiversity on land outside of state-owned protected areas, i.e. on privately/communally owned land where the landowner or user is willing to enter into an agreement.
- *Greater Cederberg Biodiversity Corridor* (GCBC – as part of CAPE) strives to introduce people to sustainable ways of using their land and the natural resources of this unique and diverse region, primarily rural communities and landowners.
- *Biodiversity Best Practices for Potato Production* includes guidelines to combine with and exposing social, economic and good governance opportunities for the industry. Core objectives for the conservation aspect of sustainability include preventing loss of threatened habitat, establishing water-use guidelines, and setting land aside in key biodiversity corridors.
- *Western Cape Integrated Water Resources Management Action Plan* aims to guide water resources related activities meeting the growth and development needs of the region, as well as to protect water resources from environmental degradation.

All these programs and projects were developed and driven by multi-stakeholder processes. Stakeholders took collective responsibility for water and land resources in order to avoid conflicts between sectors and minimize ecosystem service trade-offs. In addition, some interviewees highlighted that there have been several meetings in rural areas in the Olifants-Doorn WMA to accommodate local communities, particularly women who are not in a position to travel long distances to attend meetings. Some of these meetings and programs were supported by a moderator who mediates the different positions and requirements between state and non-state actors by using a 'language' everyone is able to understand.

Global market forces

A further driver, which is still not very prominent on political water and land management agendas, is triggered by the global market force and international trading systems. Commercial farmers have on the one side a profit motive which drives their decisions to expand or contract farming operations and the efficient use of water resources. On the other side they have to fulfil the requirements of international standards for competitive reasons. Many agriculture goods (e.g., citrus, wine) produced in the Olifants-Doorn WMA are sold to the European Union. Especially the quality of water used for irrigation is of major concern for international trade treaties like the Common Agriculture Policy of the European Union. Since the local economy and the ecology of the Olifants-Doorn WMA are closely connected they can't be dealt with in isolation. The interviewees

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mentioned that in the Olifants-Doorn WMA the impacts of effluent return flows must be monitored and reviewed on a regular basis in light of international standards. This means that the water quality management (especially monitoring of water quality) in the WMA has improved in order to ensure that export standards for the agriculture industry are met. This in turn has positive impacts on diverse regulating and maintaining as well as cultural and social ecosystem services.

Climate changes and variability

The 2013 South African Long Term Adaptation Scenario and the Fifth Assessment Report of the Intergovernmental Panel on Climate Change state that climate change poses a significant threat to South Africa's water resources, food security, health, infrastructure, as well as its ecosystem services and biodiversity (Ziervogel et al., 2014). Although climate change is a major concern to water and land resources it has the potential to trigger change towards more sustainable practices. Farmers, industries and communities need to develop strategies in order to adapt to expected climate changes. At the national level the role of climate change is given high priority. This is reflected in the development of the South African Climate Change Response Strategy (2011). This strategy was developed within a multi-stakeholder, consultative and iterative process at the national Climate Change Summit in 2009.

Climate models predict the climate of the Western Cape to be warmer and drier than present (DEA, 2013). The interviews highlighted that it is difficult to provide predictions of climate change and the resulting impacts on ecosystem services in the Olifants-Doorn WMA. Nevertheless, the interviewees jointly agree that the most vulnerable and affected livelihoods in the Olifants-Doorn WMA are the agriculture and fishing sectors and to a lesser extent the tourism sector. In order to adapt to climate changes and uncertainties, the Western Cape developed the Climate Change Response Strategy and Action Plan (Western Cape Government: EADP, 2014) in which Agriculture, tourism and fisheries were summarized as the most vulnerable sectors. Beside a review of relevant strategic documents, the process was strongly influenced by stakeholder consultation (e.g., government officials, civil society, community-based organizations, and private sector), international best practices, and expert opinions.

5.2.2 Barriers

Old and long lasting practices

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A main challenge towards sustainable resources management is to break up with old and long lasting traditions. As farmers are the main consumers of water in the Olifants-Doorn WMA they play a key role in resource protection of ecosystem services. Until 1998, when the National Water Act came into force access to water was coupled to land ownership via the riparian rights system. Together with the former restrictions on land ownership by previously disadvantaged black population, it meant that most people could not claim access to water under the 1956 Water Act. The first democratic elections in 1994 led to the National Water Act that addressed equitable access to, and government control over, water resources. Change will not come overnight and the Olifants-Doorn WMA is a good example that a transition towards full implementation of the Act takes time. The interviewees highlight that many commercial farmers in the Olifants-Doorn WMA still behave as if water is attached to their private property. From a strategical and operational point of view the interviewees mentioned that monitoring systems for water quality and quantity are weak and occur on an unregularly base and hardly any control mechanism is installed. Especially for groundwater abstraction, South Africa has made little investment in an adequate monitoring infrastructure for aquifer systems compared to that for surface water resources. Therefore, many groundwater resources (especially in the Sandveld and the Upper Olifants sub-areas of the Olifants-Doorn WMA) are developed without any observation or monitoring and evaluation mechanism. In addition to the challenges of water consumption, land clearing is a further concern towards the achievement of sustainable management. The interviewees highlighted that many farmers in the Olifants-Doorn WMA do not have permits to transform natural habitats into agriculture land or that framers have to wait for years until they receive their permits. Most of them do not know that their property is part of biodiversity hot spot areas. Currently, a program is starting to make farmers aware if their land is part of a rare flora and fauna habitat or connected to biodiversity corridors. The regional Department of Environment Affairs and Development Planning and the regional Department of Agriculture of the Western Cape together with local municipalities of the Olifants-Doorn WMA are joining forces to develop, for some farms, an environmental sensitive planning approach. This approach recognizes ecosystem services such as clean water for household water supply, irrigation and habitat ecosystem service to sustain a diversity of flora and fauna which in turn is important for the attractiveness of cultural and social ecosystem services.

Adaptation challenges to new structures

Political transformation brought many challenges for government, society, the private sector and society at large. One of the main challenges implies the required decentralization of water management issues and the delegation of responsibilities to regional or catchment level. Many interviewees highlighted that the National Water Act is

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partly too complicated and human and financial resources are lacking towards efficient implementation. Individuals and organizations are often unable to adapt to the new ways of thinking, functioning and structuring. Official authorities at regional and local levels are overwhelmed by new tasks and responsibilities, for example:

- coordinating integrated planning on a catchment basis
- developing, operating and maintaining infrastructure
- protecting water resources - rivers and streams, wetlands, estuaries and groundwater
- gender mainstreaming and initiating public participation processes
- implementing environmental education and awareness campaigns on a regular basis
- monitoring of water quality and quantity as well as land use performances.

The adaptation to new legislative structures, like the Water Act, land reform policy measures can be a challenging task for both state and non-state actors. For instance, the historically disadvantaged communities of the Olifants-Doorn WMA are invited to join meetings and participate in public forums in order to create new ideas and approaches towards more sustainable resource management. Such invitation were unheard of during the old dispensation and adapting to the participatory forums can be daunting for emerging farmers not used to participating in such fora. Knowledge about new processes is not only challenging for emerging farmers. Because the development of WUAs at the local level is a legal requirement, more information from government officials are also necessary (e.g., ecological and hydrological data, socio-economic development trends and so on). Knowledge, and the management thereof, is therefore necessary both for citizens and public officials. For instance, the interviewees mentioned that many people and communities in the WMA are not aware of what they have to do and why. This indicates the necessary interaction at a knowledge management level between at both the grassroots and government levels. The Department of Water and Sanitation as well as the Department of Rural Development and Land Reform (national and regional offices, including the individual district offices) needs to learn to provide feedback on strategical and operational management objectives in order to create awareness and to change assumptions, behaviour and perceptions.

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Limited capacity

A major barrier highlighted by the interviewees consists of capacity challenges within Department of Water and Sanitation head office as well as regional offices and in local government. After the reorganizing of the Department of Water and Sanitation many experts in the field of water and environment were substituted by administrative staff. Institutional knowledge and experience were gone due to this restructuring process. Today,

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important management positions remain unfilled as there are simply not enough trained and experienced people to fulfil the requirements of the National Water Act. The responsible employees are changing on a regular base which makes it difficult to reach a certain degree on consistency and routine. Technical and professional expertise is missing in the Olifants-Doorn WMA. The interview participants feel that this situation can be traced back to the fact that there is neither strong leadership at national level nor water champions at catchment level which are important for successful adoption of knowledge and to promote the adoption of new ideas.

A further and rather sensitive point raised by the interviewees was that cooperation between state and non-state actors is weak because a lack of the communication and knowledge transfer from state actors to stakeholders in rural areas. One reason is the language barrier. The stakeholders in the Olifants-Doorn WMA are primarily Afrikaans speaking and it will be a requirement for state actors to be able to communicate in this way. Unfortunately, many staff members of the Department of Water and Sanitation are not Afrikaans speaking which make communication difficult and constitute, consequently, a barrier to increase trust between the Department and farmers or rural and former disadvantaged communities.

Beside the lack of experts, responsibilities and the language barrier the interviewees highlighted the shortage of adequate data both hydrological as well as socio-economic. This can be related to the lack of cooperation and information sharing across several departments responsible for cross-cutting issues of water and land resources.

6. Discussion

The discussion summarizes important implications for ecosystem services which were deduced from the identified drivers and barriers. Based upon these implications, we outline main requirements and developments towards more sustainable water and land management in the Olifants-Doorn WMA.

6.1 Implications for ecosystem services

Identifying causal relations between the governance and management of natural resources and their performance with regard to impacts on ecosystem services is not a trivial task. In general, it is assumed that a command and control approach results in a reduction of the natural range of ecosystem services while an integrated and adaptive approach provides a more promising approach to the protection of nature (Gunderson and Holling, 2001). According to Primmer and Furman (2012), the governance and management of ecosystem services requires the integration of multiple knowledge sources and engaging of actors able to understand and manage the interlinkages of ecosystem services. Furthermore, the integrated and adaptive approach considers the fact that

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ecosystem services are complex, their interdependencies are difficult to understand, and the consequences of human intervention are hard to predict. In other words, the integrated and adaptive approach acknowledges and embraces complexity thinking to a much larger extent than the command and control system of management.

The drivers and barriers towards more sustainable water and land management in the Olifants-Doorn WMA indicate that different aspects of an integrated and adaptive approach are existing such as institutional settings, bottom-up movements, global market forces as well as climate change and variability. The case appears that changes in institutional settings are necessary (but not sufficient) to maintain different ecosystem services. Yet, institutional settings influenced bottom-up movements at catchment level such as the Cape Action for People and the Environment or the Biodiversity Stewardship Program which in turn attempt to protect especially slowly changing factors underlying regulation and maintenance ecosystem services (e.g., soil fertility and groundwater levels). It is often these slowly changing factors that lead to unanticipated regime shifts in ecosystems that can cause rapid, irreversible changes in ecosystem services and human well-being (Carpenter et al., 2009).

Due to the barriers we identified in the Olifants-Doorn WMA we state that management approaches tend to neglect regulation and maintenance as well as cultural and social ecosystem services in favour of short-term provisioning services (e.g., water for irrigation and food production). Especially long lasting practices of irrigators and farmers as well as limited capacities of water and land managers lead to negligent disregard of regulation and maintenance as well as cultural and social ecosystem services. One reason might be that many water and land managers and politicians often lack knowledge and awareness of the interactions (and the implications of these interactions) between different ecosystem services and, therefore, fail to manage natural systems appropriately (Braat and de Groot, 2012). One of the most significant challenges in the Olifants-Doorn WMA, as well as in many other catchments worldwide, is integrating social and ethical factors together with environmental aspects into the water and land management sectors (Norgaard, 2010). Social and ethical factors, therefore, go much wider than the mere provisioning of water for irrigation and food production, but entails also decisions about stewardship of the different resources as well as the interaction between ecosystem services and humans. Such decisions can hold implications for future requirement and developments regarding sustainable land and water management.

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6.2 Future requirements and developments

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One main conclusion from the interviews is that the enthusiasm of stakeholders participating in workshops and programs towards more sustainable land and water management decreased. Many stakeholders are saturated of public meetings or consultation hearings and are not willing to participate in further discussions. The lack of feedback from official state authorities both national and regional to the stakeholders makes them unsatisfied and produces a fracturing of trust. This in turn can be a major issue for ecosystem services because the heterogeneous interests and goals of stakeholders in the Olifants-Doorn WMA might be simultaneously affected. Beside this, further challenges must be solved if water and land resources should be maintained for long term usage and to secure livelihoods for further generations. Based upon these implications we summarize different approaches and measures relevant to address stakeholder fatigue and for the sustainable development of water and land resources management:

- The constitution of a CMA which is supposed to start operating within the next 4 to 5 years. The CMA will act as the organ between local stakeholders and state officials responsible for water and land management at higher government levels. This intermediary role on the part of the CMA allows improving the knowledge transfer across actors in different positions within a hierarchical decision making structure, holding diverse values and management goals. This information exchange is assumed to create trust, more transparency as well as accountability between state and non-state actors and could have a positive effect on people's attitude and behaviour towards water and land resources. Said differently, it could have a positive influence on the fatigue stakeholders feel towards meetings and public hearings. In this context, the ecosystem services concept might become an essentially stakeholder-driven approach (cf. Menzel and Teng, 2010). It is important to note that the Berg WMA and Olifants-Doorn WMA will be joined in the future. Therefore, only one CMA needs to be established.
- Closer cooperation between farmers and the regional Department of Water and Sanitation as well as the Department of Agriculture is necessary to implement more sustainable farming practices and land-use planning. The regular exchange of data and information allows the building of mutual trust between all stakeholders and state departments. An online database and water, land, social and economic monitoring systems provide an opportunity for regular information exchange. Monitoring allows for stricter rules and restrictions on the use of water and land resources (especially provisioning ecosystem services such as water used for irrigation).
- Cooperation between different government departments is necessary to achieve environmental objectives, especially between the Department of Water and Sanitation, Department of Environmental

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Affairs and Development Planning, Department of Agriculture, the South African National Biodiversity Institute, provincial environmental departments, local government, and South African conservation agencies (e.g., CapeNature). This is important, because farmers and industries using water and land resources, often need to obtain two or more authorizations like environmental authorization, waste-management license and water use license. Communication between different government departments could facilitate the reduction of so-called administrative 'red tape' when farmers and industries need to apply or renew authorizations.

- To prepare the Olifants-Doorn WMA for expected climatic change and to distribute water to more arid areas in the WMA, the raising of the Clanwilliam Dam has been approved by cabinet. Even so, built infrastructure only will not solve water shortages; it merely provides an additional approach of water storage especially during dry periods. A feasibility study, finalized in October 2007, was undertaken to consider all the implications of raising the dam. The additional yield from raising the dam wall, allowing for current water allocation, upstream use and ecological water requirements, was assessed as 69.5 million m^3 per annum. This additional yield could provide an opportunity to establish resource poor farmers to promote food security and employment through inclusive economic growth. It should also be noted that by securing more water in light of expected climate change, increasing the capacity of the Clanwilliam Dam need to be considered together with the governance measures we propose above.

7. Summary and conclusions

The objective of the article was to identify drivers and barriers towards the sustainable management of water and land in the Olifants-Doorn WMA in South Africa. Results, obtained from a literature search and qualitative interviews, indicate that drivers refer to changes in institutional settings, bottom-up movements, global market forces, climate change and variability while barriers refer to old and long lasting practices, adaptation to new structures, limited capacities, lack of cooperation and coordination. Especially, complex and dynamic multi-actor problems provide a barrier towards integrated water and land management, characterized by structural uncertainties in knowledge and a diversity of perspectives on what the problem actually is and how it should be solved. Nevertheless, the complexity of the Olifants-Doorn ecosystem services should not deter stakeholders from achieving integrated water and land management for the betterment of humans and the environment. A high degree of participation and cooperation often improves the quality of solutions by including diverse sources of knowledge and experience. Therefore, it is vital to put in place decentralized and localized management structures (e.g., in the form of a CMA and WUAs) populated by the individuals with the knowledge and

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experience on how to manage the WMA and its ecosystem services. In addition, the establishment of sufficient water and land monitoring systems are necessary for decision makers, farmers and local water suppliers. Monitoring ecosystem services are an essential tool for communicating complex patterns and processes to decision-makers and measuring the success of conservation actions (Anton et al., 2010).

If the Olifants-Doorn WMA succeeds in establishing decentralized and localized management structures as well as sufficient water, land, social and economic monitoring systems then it might be able to improve coherence across sectors and actors and overcome political boundaries inhibiting efficient use of water and land resources. This can only be achieved if the Department of Water and Sanitation effectively fulfil its roles and responsibilities especially regarding the establishment of the CMA for the WMA. One needs to be aware that the suggested ideas and insights from the interviewees are no panaceas for sustainable water and land management, but they do provide a summary of urgent barriers that must be tackled in the Olifants-Doorn WMA.

Albeit drivers and barriers towards sustainable water and land management are case and, hence, context specific, we want to make the reader of this article aware, that other southern African countries and their river basins facing similar challenges. Beside physical and ecological circumstances socio-economic aspects are strongly linked with sustainable water and land management (e.g. Conway et al., 2015). For example, within the Southern African Development Community (SADC), institutional settings such as water and irrigation plans are being written or revised in order to improve sustainable water and soil delivery (Swatuk, 2005). The implementation of these plans are, however, not trivial and require more decentralized and participatory approaches as well as the political will of each country.

Acknowledgement

This article is an outcome of the project WaterNeeds (www.waterneeds.uni-osnabrueck.de). Funding by the German Research Foundation (DFG) is hereby gratefully acknowledged (PA 351/8-1). Thanks go to Elisabeth Ehling for her support during data collection in South Africa. Many thanks also to all interviewees in South Africa for their time, cooperation and valuable case study information.

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