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IMPLEMENTING INTEGRATED WATER RESOURCE MANAGEMENT (IWRM)

The Olifants-Doorn Case Study and Pointers to Implementation

WATER RESEARCH COMMISSION

ABOUT THIS PUBLICATION

This publication is compiled from the Water Research Commission (WRC) Research Report entitled INTEGRATED WATER RESOURCE MANAGEMENT (IWRM): FROM THEORY TO PPRACTICE, FROM POLICY TO OUTCOMES (WRC Report No. 1975/1/14) by Lewis Jonker.

It is written for those involved in water resource management (WRM) in municipalities, and regional and provincial offices of government with a water management function, and national government departments with a water management function – Departments of Water and Sanitation (DWS), Agriculture, Mineral Resources, Energy, Trade and Industry, Tourism, Environmental Affairs, and Cooperative Governance and Traditional Affairs.

The document provides an understanding of the term IWRM and its evolution, gives a sense of the difficulties in implementing IWRM, highlights the Olifants-Doorn Water Management Area (WMA) as a case study in IWRM implementation, and provides guidance on implementing IWRM in a simple, non-complicated way.

To obtain the full WRC Report No. 1975/1/14 contact:

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ACRONYMS

DANIDA	Danish International Development Agency
DWS	Department of Water and Sanitation
EWR	environmental water requirements
GWP	Global Water Partnership
IUA	integrated unit of analysis
IWRM	integrated water resource management
MC	Management Class
SADC	Southern African Development Community
UN	United Nations
WMA	Water Management Area
WRC	Water Research Commission
WRM	water resource management

1 WHAT IS INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)?

Historically, managing water resources has been about predicting demand, and looking for water resources to develop in order to supply the demand through the construction of dams and reticulation systems. Over time, and particularly in water scarce regions, the ability to "supply demand" has diminished, and new ways of managing water have emerged.

Allan (2006) identifies five water management paradigms that have influenced water resource management (WRM) over time:

1. Pre-Industrial Revolution – where water was required for domestic and livelihood purposes, and the source of the water was localised.
2. 19th to mid-20th century: the "hydraulic mission" – where science and engineering played a central role. There was a sense that nature could be controlled and governments, agricultural interests, power generators and other large water users scrambled to secure water for their constituencies.
3. Late 1970s and 1980s – where environmental water requirements were seen to be paramount in the context of nature being outside of human control.
4. 1990s – where water was recognised as an economic good with economic value, and water needed to be allocated efficiently.
5. Starting in 1992 – where WRM was seen to be a political process, and the notion of integrated water resource management (IWRM) was put on the international water agenda at both the United Nations (UN) Conference on Environment and Development in Dublin in January 1992, and elaborated on at the UN Conference in Rio de Janeiro in July 1992.

The main outcome of the Rio Conference was Agenda 21 (UNEP, 1992). Chapter 18 of Agenda 21 focuses on IWRM. It contains a description of the hydrosphere and factors that impact on it, trans-boundary water resource issues, and it has seven programme areas.

There has been a concerted international push for IWRM using Agenda 21. The World Water Council was established to promote IWRM. The Global Water Partnership (GWP), together with regional offices and country partnerships, was established to promote IWRM dialogue and to encourage transformation of water policies to IWRM-friendly policies. Regional political groupings (such as the Southern African Development Community [SADC] and the European Union) have encouraged member states to accept IWRM as their water management paradigm. SADC reaffirmed its commitment to IWRM in its "Regional Strategic Action Plan on Integrated Water Resources Development and Management" (2011-2015) (SADC, undated), generally referred to "RSAP III".

Chapter 18 of Agenda 21 highlights two aspects of WRM that must be integrated:

1. Water must be used for the benefit of

people i.e. **access** to water.
2. The environment must be protected i.e. **sustainability** of the resource.

There is general agreement that there are four types of **access** to water:

1. Basic human needs. This is water for drinking, cooking, personal hygiene and laundry.
2. Water for productive purposes. This includes water for agriculture, industry, power generation and mining. It may include water for food security, and small business activities such as stock watering and car washing.
3. Economic opportunities. These opportunities are of different kinds, and may also be termed job creation.
4. Water for cultural purposes. (This last point is not covered in South African literature, but includes religious and cultural activities).

Drawing on the thinking of Broman et al. (2000) and Falkenmark (2003), there are four system conditions for **sustainability** of the resource; and these are dependent on the willingness and ability of people not to subject water resources to the following:

1. Accumulation of material from the earth's crust (after-use alterations and pollution load). An increase in concentration of materials from the earth's crust results in pollution from primarily cations, anions and trace metals causing eutrophication, acidification, and salinisation.
2. Accumulation of manufactured material (after-use alterations and pollution load). An increase in concentration of manufactured materials results in pollution from biocides, pharmaceuticals, persistent organic pollutants (POPs) and litter (including electronic litter).
3. Impoverishing physical manipulation (flow-control measures). Impoverishing physical manipulation of the resource disrupts the water cycle as a result of the canalisation of rivers, construction of dams and removal of vegetation, especially riparian vegetation.
4. Over-abstraction (water withdrawals). Over-harvesting through over-abstracting and not providing for environmental flows.

The Research Report states that, to achieve IWRM, water users must focus their activities on four domains:

1. Resource protection. What are the required actions to ensure that water resources are protected from abuse?
2. Appropriate land use. What are the appropriate land-use practices that will not compromise the sustainability of water resources in a catchment; and at what stage in the life of a catchment do land-use practices cause compromises that will be irreversible?
3. Optimal water use. What water conservation and water demand management tools are being used to optimise water use, and is water use the most efficient possible?

4. Governance. What approaches to water governance will facilitate the provision of access and ensure sustainability?

Conceptualising IWRM in terms of access and sustainability, with the four domains of resource protection, appropriate land use, optimal water and governance, allows for different water sub-sectors to focus on what is best for that particular sub-sector while at the same time providing sufficient guidance on how to achieve the water management outcomes.

2 IS IWRM IMPLEMENTABLE?

IWRM had become an internationally accepted and supported approach to water management by the year 2000. However, it is important to note that it has also come under strong criticism, including from those who previously supported it.

Walther (1987), White (1998), Jewitt (2002) and Biswas (2004, 2008) are among those who question the usefulness of IWRM as an approach to water management. In 2008 Merrey wrote, “It is time to abandon Integrated Water Resources Management (IWRM) as a guide for implementation” (Merrey, 2008:899). The three dominant criticisms in the literature (and raised in the Research Report) are:

1. IWRM cannot be operationalised.
2. IWRM cannot be measured.
3. The science of IWRM is problematic.

In contrast to those who say it is impossible to implement IWRM, there are others who believe IWRM implementation may be uneven, but it is certainly possible to implement (Swatuk, 2005; Jonker, 2002, 2007; Van der Zaag, 2005; Koudstaal, et al. 1992; Jeffrey and Gearey, 2006).

Moriarty et al. (2010) are of the opinion that in developing countries IWRM as conceptualised by GWP cannot be implemented, but that “'light' integrated water resource management (IWRM): that is, IWRM that is opportunistic, adaptive and incremental in nature and clearly focused on sustainable service delivery” can be implemented.

South Africa, in its legislation and policy, fully supports IWRM. In the introduction to the 2004 National Water Resource Strategy the then Minister of Water Affairs and Forestry, Ms Buyelwa Sonjica, wrote: ”As enshrined in the National Water Act, integrated water resources management is intended to enable us to meet the needs of our people for water, jobs and economic growth in a manner that also allows us to protect and where necessary, rehabilitate our aquatic ecosystems” (p.6). The National Water Resource Strategy is informed by the 1997 Water Policy and the National Water Act of 1998 and is a most powerful statement of the intention that water management practices in South Africa will follow an IWRM approach.

The following section looks at implementing IWRM by the DWS in the Olifants-Doorn WMA, and provides an opinion on how well this has been done i.e. as a case study in whether IWRM is implementable or not.

3 IMPLEMENTING IWRM IN THE OLIFANTS-DOORN WATER MANAGEMENT AREA (WMA)

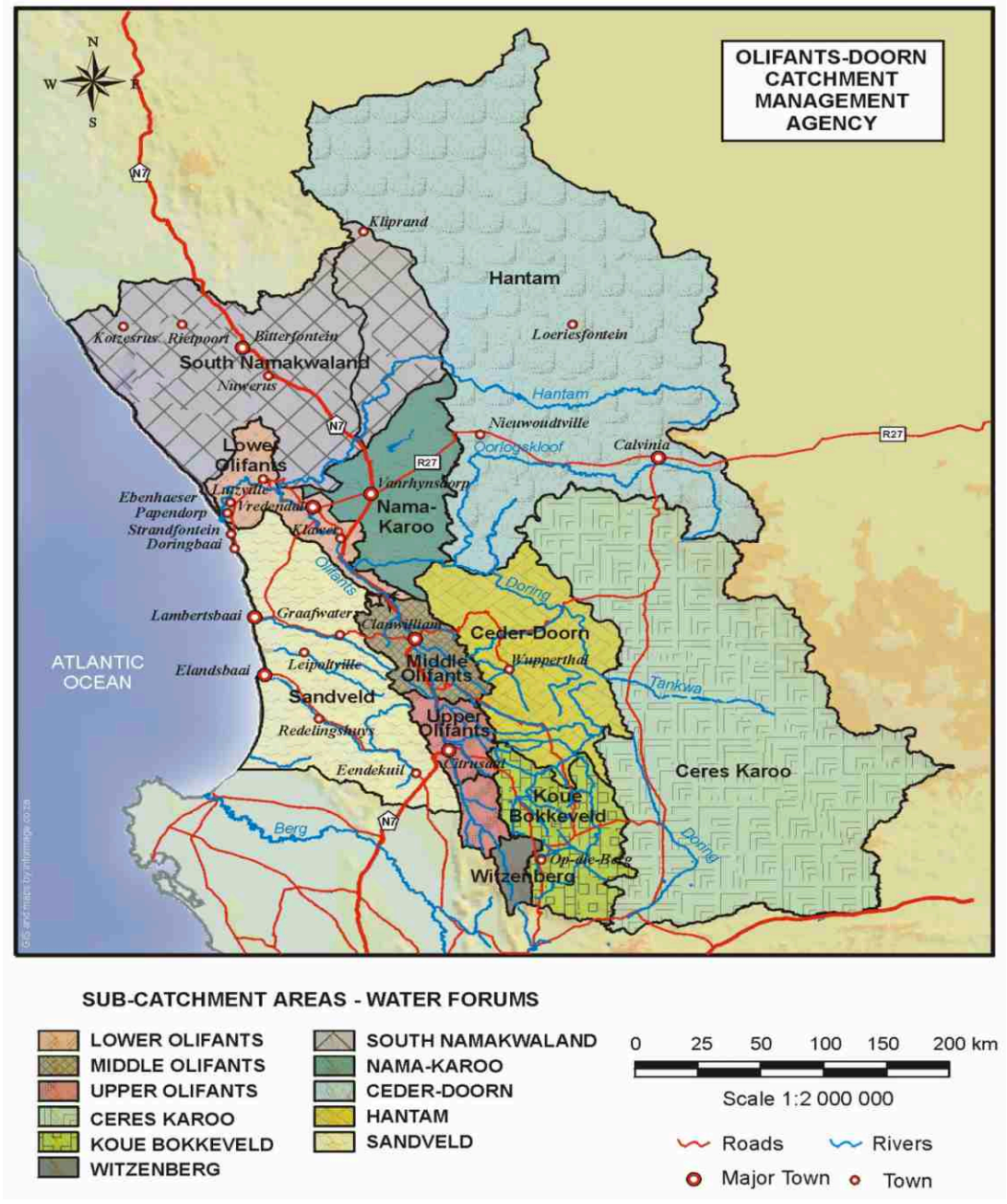

Figure 1: Map showing the geographical area in the Western and Northern Cape of the Olifants-Doorn Catchment Management Agency

3.1 Access

As noted above, access includes water for basic human needs, productive purposes, and economic opportunities.

Based on data supplied by Statistics South Africa (2012) Table 1 below shows that in the two municipalities (Matzikama and Cederberg) that wholly fall within the boundaries of the Olifants-Doorn WMA, 96.4% of people in the case of the Matzikama Municipality and 97.7% of people in the case of the Cederberg Municipality have access to water for basic human needs.

	Municipality			
Water source	Matzikama WC011		Cederberg WC012	
	No. of house holds	%	No. of house holds	%
Piped water inside dwelling/institution	13579	72.1	10148	75.1
Piped water inside yard	3624	19.2	2636	19.5
Piped water on community stand: less than 200 m from dwelling	958	5.1	415	3.1
Piped water on community stand: between 200 m & 500 m from dwelling	122	0.6	74	0.5
Piped water on community stand: between 500 m and 1 km from dwelling	27	0.1	46	0.3
Piped water on community stand: greater than 1000 m from dwelling	9	0.0	69	0.5
No access to piped water	517	2.7	126	0.9
Total	18836	100	13514	100

Table 1: Access to water for basic human needs (Source: Statistics South Africa, 2012)

In the Olifants-Doorn WMA access to water for productive purposes is primarily water for agriculture with small amounts to industry (wine cellars) and mining (Namakwa Sands). Within the Olifants-Doorn WMA emerging farmers have gained access to water through a project jointly funded by the DWS and the Danish International Development Agency (DANIDA). At least 400 people in 41 communal projects were given access to water, land and other resources (finance, training, advice). Twenty-six of the projects are related to agriculture either for small-scale farming (17 projects), food gardens (5 projects) and livestock production (4 projects). The project started in August 2006 and ended in June 2009, and is an example of addressing access to productive water to emerging (new entry) farmers. Further, commercial agriculture in the form of grapes, citrus, deciduous fruit and potatoes is mature.

In the Olifants-Doorn WMA a number of economic opportunities have been created. These include in training (establishing food gardens; multi-purpose use of fruit trees; water-awareness programmes; community empowerment projects – a total of 4 projects); tap and leak repairs (2 projects); eradication of invasive alien plants and rehabilitation of eroded river reaches (2 projects); project management of food gardens in schools and rain-water harvesting facilitation (4 projects); and groundwater monitoring (3 projects).

3.2 Sustainability

As noted above, the four system conditions for sustainability are accumulation of material from the earth's crust, accumulation of manufactured material, impoverishing physical manipulation, and over-abstraction.

Chapter 3 of the National Water Act places on government the responsibility to put measures in place for the comprehensive protection of all water resources. The resource-directed measures (directed at the water) are the Classification System, the Ecological Reserve, and Resource Quality Objectives. The source-directed controls are aimed at preventing pollution.

The Classification System establishes three Management Classes (Mcs):

1. Class I – a water resource that is minimally used.
2. Class II – a water resource that is moderately used.
3. Class III – a water resource that is heavily used.

Once a class has been assigned to a water resource, the description of the class must include "(a) the extent of the use of the resource, (b) the Reserve, (c) the resource quality objectives and (d) the determination of the allocable portion of the water resource for use" (Republic of South Africa, 2010).

In October 2010 the DWS employed consultants to determine the MCs for the water resources in the Olifants-Doorn WMA. In their report the consultants noted: "The MC of an aquatic ecosystem will reflect the future desired condition or health of the system, and will be used to guide the amount and quality of water to be reserved for the ecosystem. Deciding on the MC of a system will involve consideration of a broad range of issues and a set of related processes that will include water resources planning, catchment management planning as well as the Classification Process itself. It is important to understand that the product of a Classification Process is the assignment of a management class to water resources within a catchment, i.e. rivers, wetlands, groundwater and estuary. This outcome may influence the water yield that can be utilised from the resource, and indirectly activities within the catchment such as land use" (Belcher and Grobler, 2012).

The implication is that the Ecological Reserve is determined once an MC has been assigned

to the water resource. For the purposes of the classification process, the Olifants-Doorn catchment was divided into seven integrated units of analysis (IUAs):[1]

1. Knersvlakte IUA.
2. Lower Olifants Irrigation IUA.
3. Olifants/Doorn Dryland Farming IUA.
4. Upper Olifants Irrigation IUA.
5. Doring Rangelands IUA.
6. Koue Bokkeveld IUA.
7. Sandveld IUA. (However, because the Sandveld falls outside the Olifants-Doorn catchment boundary it was excluded from the research.)

Once the IUAs have been selected and delineated, the class configuration of each IUA is determined, either as Class I, II or III. This classification of the bigger unit subsequently has an effect on the classification (catchment configuration) of the quaternary catchments within the IUA. Factors taken into consideration when determining each MC in the Olifants-Doorn catchment were the quantity and quality of water, aquatic ecosystems, economic activity and social status of people living in the catchment. The class configuration was shaped by the ecological state as determined in 2006 and the freshwater ecosystem priority areas in the WMA as determined in 2011 (Nel et al., 2011).

The MC of each IUA is determined at the outflow of the IUA and a specific combination of the MCs of the quaternary catchment contained in that specific IUA add up to that MC. The MCs for the different IUAs in the Olifants-Doorn are as follows:

1. Knersvlakte IUA – Class I
2. Lower Olifants Irrigation IUA – Class III
3. Olifants/Doorn Dryland Farming IUA - Class III
4. Upper Olifants Irrigation IUA – Class III
5. Doring Rangelands IUA – Class I
6. Koue Bokkeveld IUA – Class II

Estuaries occupy an ambivalent position in water resource management. Indications are that although estuaries are at the bottom end of the river they are being managed as “natural” areas rather than water resources. They have a significant influence on WRM in that they determine the amount of water required to keep them in a desired state. In the Olifants-Doorn WMA the Olifants Estuary is important for a number of reasons, and the decision was that it should be maintained in a Category C ecological category (i.e. “moderately modified” – in terms of the River Health Programme assessment). This places certain demands on water requirements that the Olifants River cannot provide because of historical developments in the Olifants River. The environmental water requirements of the Olifants Estuary must therefore be met from the Doorn River that in turn places a limit on the developments in the Doorn River catchment. To accommodate the water provision to the estuary from the Doorn River, many of the quaternaries in the Doorn catchment have been assigned a Class I (minimally used) classification compared to the

[1]An IUA is a designation for the geographical space that contains the biophysical and socio-economic elements pertaining to a specific water resource.

River Health Programme[2] assessment in terms of which a significant number of quaternary catchments were assigned a Category C ecological category.

An assessment of the health of the rivers in the Olifants-Doorn WMA was published in 2006 (River Health Programme, 2006). This State of the River Report presents the assessment as the current ecological state (EcoStatus) of the river and an envisioned future state (desired state), mostly presenting an improved ecological condition. The EcoStatus and desired state for the Olifants-Doorn Rivers are presented in Figure 2 below. In the maps the colour blue represents MC I, green represents MC II, and red represents MC III.

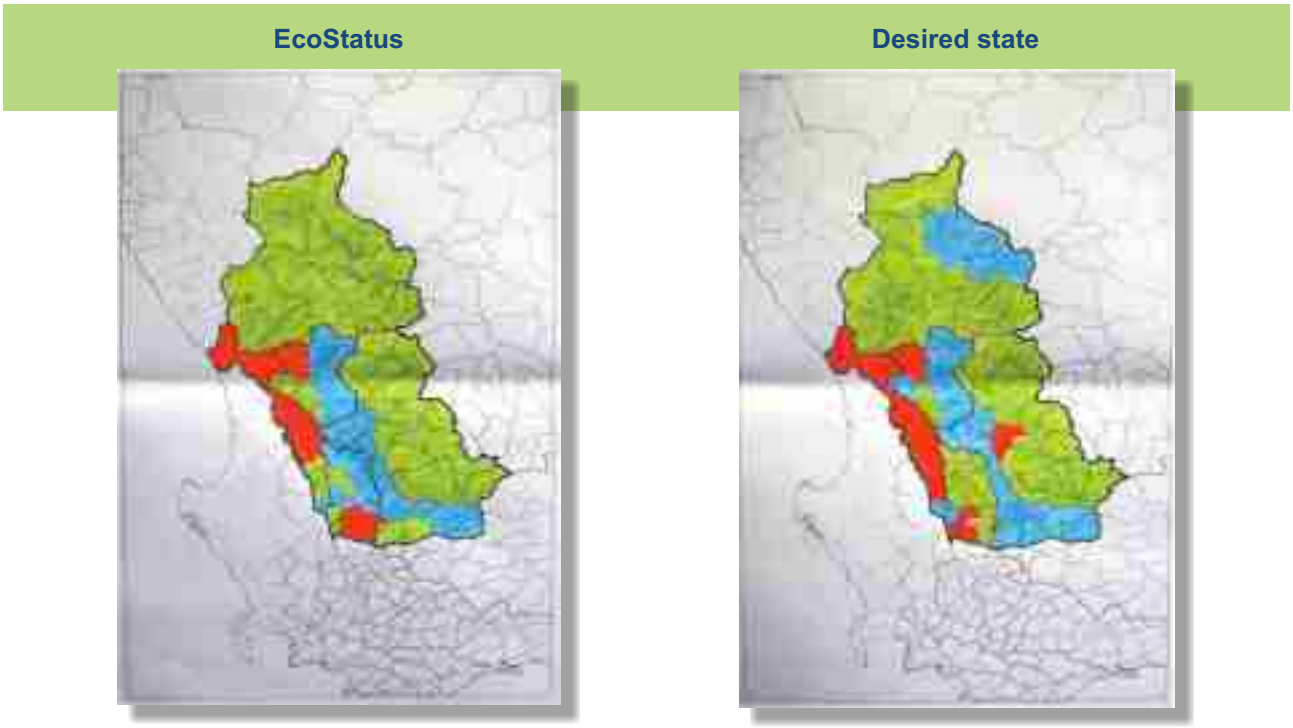

Figure 2: Comparison of the EcoStatus and desired state of the rivers in the Olifants-Doorn Rivers

In addition to the ecological status of rivers, the State of the River Report for the Olifants-Doorn Rivers also identifies the major impacts on the rivers and management actions to counter the impacts. Examples of management actions aimed at the Olifants River are: "reduce the cumulative effects of small farm dams in the catchment; investigate environmental flow release options from the water supply scheme, and no further in stream dams should be built in the catchment". Examples of management actions aimed at the Doorn River are: "no

[2]Since 1994, the then Department of Water Affairs and Forestry developed a number of tools to address the issue of sustainability. The River Health Programme initiated in 1994 is one such tool. The River Health Programme assesses the condition (health) of a river using river-health indices derived from ecological indicator groups.

further in stream dams should be built in this catchment, and improve regulation of abstractions in the Doring River tributaries".

In the Olifants-Doorn WMA the determination of the Reserve was completed in June 2006 (signed off in July 2008). The Water Resource Classification System was completed in 2007 and gazetted in 2010. The completion of the classification in 2012 used the 2010 Water Resource Classification System, and the Reserve determinations were based on the environmental flows for the Recommended Ecological Class (as determined in 2006). "The Olifants-Doorn Catchment was used as a proof-of-concept catchment for the development of the Water Resource Classification System. This means that, although a Classification Process has not been conducted, much of the information required for such a process has already been generated for the Olifants-Doorn Catchment" (Shippey et al., 2009:35).

3.3 Conclusions regarding implementing IWRM in the Olifants-Doorn WMA

From the above discussion the following conclusions are drawn in terms of implementing IWRM in the Olifants-Doorn WMA:

1. That providing access to basic water is being achieved although in many cases the provision is still from a standpipe more than 200 m away from households. Achieving 96.4% and 97.7% coverage in the Matzikama Municipality and Cederberg Municipality, respectively, is a notable achievement. However, 3.4% and 2.2% of households are without the minimum standard of water supply; although these percentages seem low, they represent 778 and 315 households in the Matzikama and Cederberg Municipalities, respectively. These remain significant inadequacies.
2. That providing access to productive water is being achieved. For small-scale emerging farmers primarily through general authorisations, and for established commercial farmers through existing lawful use provisions and licenses. The sustainability of the emerging farmers remains vulnerable because of the number of participants per project in relation with the size of land allocated to them. The classification process also identified additional allocations to certain parts of the Olifants-Doorn WMA that will make a significant contribution to the expansion of agriculture.
3. The provisions of Chapter 3 of the National Water Act have been implemented in that the water resources in the Olifants-Doorn WMA have been classified and the Reserve has been determined. Although the resource quality objectives (RQOs) have not been determined according to the guidelines published in March 2011 (Department of Water Affairs, 2011), indications of what the RQOs could be are included in the

Reserve determinations as well as in the report on the classification process. In short, all the elements required by the National Water Act to ensure sustainability of the water resources in the Olifants-Doorn WMA are in place.

4. No evidence has been found of a systematic implementation of the recommendations contained in the State of the Rivers Report: Olifants/Doring and Sandveld Rivers (River Health Programme, 2006), or the Reserve determinations that were used in the water licensing process in the Olifants-Doorn WMA since 2006, or that mechanisms to monitor flow and quality have been put in place. This indicates that the progress that is required in identifying the nature and extent of the resource protection measures is not matched by progress in action to implement the protection measures.

On balance, it is fair to say that enormous progress has been made in implementing IWRM in the Olifants-Doorn WMA. However, given the complexities of implementing IWRM, and because of the identified gaps, it is proposed that the "light touch" approach (i.e. opportunistic, adaptive, incremental and focused on sustainable service delivery) to implementing IWRM be favoured.

4 POINTERS TO IMPLEMENT "LIGHT TOUCH" IWRM

The Research Report coins the phrase "naïve model" in terms of reducing complexity and providing a simple, step-by-step process to implement IWRM.

In constructing a naïve model the largest possible unit of a phenomenon must be identified and labeled as the "system". Subsequent steps entail the progressive identification of layers or "sub-systems".

Steps A – D constitute the construction of a naïve model for implementing IWRM in a WMA:

A. Determine the allocation of water

1. Determine the amount of water available in the catchment (water resource assessment).
2. Determine the environmental water requirements (EWR).
3. Determine the basic human needs of the people living in the catchment.
4. Calculate the water available for allocation. Water available for allocation is total water available minus the EWR and water for basic human needs. The water available for allocation to users includes that portion available for inter-basin transfers.

B. Ensure that the EWRs are met (meeting the sustainability requirement of IWRM)

1. Start with the EWR at the primary catchment outlet.
2. Then move up the catchment and

decide on the contribution each secondary catchment can make to the EWR at the primary catchment outlet.

3. The limit each secondary catchment can make to the EWR of the primary catchment is determined by the EWR at the outflow of each secondary catchment.
4. The process continues upstream up to the tertiary catchments, if required.

C. Ensure that water quality requirements are met (meeting the sustainability requirement of IWRM)

1. To meet the national water quality standards for the environment as recommended by the DWA guidelines.
2. The standards get improved by a system of regular monitoring and assessment.
3. Quality is monitored at the same sites where the EWRs are monitored.

D. Ensure sufficient water is available for allocation (meeting the access requirement of IWRM)

1. Water needed throughout the year for domestic, industrial use and agriculture use means storage is required.
2. Impoundments amount to impoverishing physical manipulation that contravenes a systems condition of sustainability.
3. However, the Berg River Dam has shown that an impoundment can be designed that makes provision for environmental flow releases.

The approach set out above can initially be implemented in a small catchment and, once the method has been improved, can be up-scaled to a bigger catchment. Or it can be implemented in a number of tertiary catchments and then up-scaled to the secondary catchment of which the tertiary catchments are part. The approach as set out above allows experimentation with different formats of catchment combinations with increasing complexity and in which the non-linear relationships can be identified, understood and managed.

5 CONCLUSION

The research set out to understand whether IWRM is implementable and how. Since 1994 South Africa has made great strides in transforming WRM, and tracing the evolution of IWRM in South Africa, indications are that DWS has mostly got it right.

The outcomes of the research in the Olifants-Doorn WMA illustrate that the concept of IWRM is indeed implementable to a very large degree.

The dearth of positive outcomes in implementing IWRM in South Africa post 1998 i.e. since the policy and legislation for implementing IWRM were put in place, are

mostly be laid at the door of the ethos (or organisational culture) in DWS, and the lack of integration of issues between DWS and the National and Provincial Departments and Regional Offices of Agriculture (agricultural water use), Mineral Resources (mining), Energy (power production), Trade and Industry (other industrial water use), Tourism (recreation and tourism), Environmental Affairs (environmental use), and Cooperative Governance and Traditional Affairs and municipalities (domestic water use and water management) – all of whom carry a water management mandate.

Most of the data indicates there is a hesitancy to implement IWRM within DWS, a fear of making mistakes. This statement is supported by anecdotal evidence (Schreiner, 2013) and by the views of ex-employees of the Department (Jonker et al., 2010).

Therefore, courage and an uncomplicated approach – such as provided in the naïve model, will go a long way towards implementing IWRM countrywide.

Repurposed for a wider audience by

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