3. The need of Water Management Efficiency for successful IWRM Implementation – a short MOSA Project Summary

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3.1 MOSA Findings

South Africa has ambitious water-related development goals, e.g. to "ensure that all South Africans have access to clean running water in their homes", to "produce sufficient energy [...] while reducing carbon emissions" and to "realise a food trade surplus" (National Planning Commission 2012, p. 24). These goals are in line with the Sustainable Development Goals (UN 2015) or even surpass them. This small sample of goals named shows the inextricable linkages of water, energy and food – the water-energy-food nexus (e.g. WWAP 2014, pp. 54-61) – and highlights the enormous challenges for South Africa and all other countries under similar social, environmental and economic conditions.

The Olifants River catchment is one of South Africa's most stressed catchments as far as water quantity and water quality is concerned. The applied research project MOSA – Integrated Water Resources Management in the 'Middle Olifants' river basin, South Africa, Phase II – has been funded by the German Federal Ministry of Education and Research (BMBF) to develop and demonstrate exemplary measures and tools to support integrated water resources management.

The MOSA project has confirmed the observation that sustainable water management in the project region is rather a matter of practical implementation than of comprehensive concepts or legal conditions. The enabling framework "is in place to support IWRM" (Claassen 2013, p. 329), water institutional reforms have been implemented since the end of Apartheid in 1994 (e.g. Backeberg 2005) and South Africa "has established a highly ambitious body of water legislation [but] is now struggling with its implementation" (Herrfahrdt-Pähle 2010, p. 20). There is a strong need to transfer the concepts and legal provisions quickly into institutional structures and practical

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application. To give an example: the establishment of the Olifants Catchment Management Agency according to the National Water Act (RSA 1998, Chapter 7) has been proposed in 2002 (DWA 2013, p. 22) and was finally gazetted in 2015 (DWS 2015a). It will take additional time until the Olifants CMA is fully effective.

As Claassen, Funke and Nienaber pointed out, the future of the South African Water sector – as well as the condition of the vulnerable water resources – depends on effective action towards sustainable development (Claassen et al. 2013). It is all about the combination of effectiveness and efficiency. The enabling framework to do the right things has been established, now it is time to do the things right, or (generalising Drucker (1963)) – to strive for the most sustainable results from the resources currently available.

The MOSA applied research project addresses a wide range of water-related research questions that are relevant both for the South African project region and in general for the sustainable use of water resources in Africa and beyond. The project partners developed transferable IWRM tools and concepts and demonstrated practical intervention measures in close cooperation with several cooperation partners and stakeholders from administration, academia and industry.

These solutions are in line with the goals of the BMBF funding priority (BMBF 2015) as well as urgent South African water research questions (Siebrits et al. 2014). The Mobile Monitoring Station and the Decision Support tools for example address "significant gaps [...] in monitoring and decision support" (Claassen 2013, p. 334) of South African water management.

Vast areas in the Olifants project region are poorly serviced by laboratories (Balfour et al. 2011, p. 45) to monitor water quality and compliance to legal regulations. Mobile online water quality monitoring has many advantages compared to external laboratories far from the study area as shown in several monitoring campaigns during the project duration, especially with regard to credibility of results and integrity of samples (see Chapter 2.3 and Balfour et al. 2011, p. 39). After the end of the project, the Mobile Monitoring Station will still be available for further monitoring campaigns and training and demonstration activities in South Africa to give students and users practical experience in water quality monitoring.

The Decision Support Tools, like the risk assessment tool (Chapter 2.1) and the hydrological model including water quality aspects (Chapter 2.2), support stakeholders in their decision making processes and allow for cost efficient handling of financial resources, as they are able to identify priority areas for further investigation and water management interventions. The risk assessment model developed by eE+E and the Disy data warehouse are used by DWS for tests and practical application since the end of 2014. An expansion of the methodology to other regions would be a logical next step. The MIKE model developed by DHI under the MOSA project has also been handed over to the DWS for application.

The effect of water policy reforms on water use efficiency and impacts of transaction costs on the success of water policy reforms and on water quality have been analysed by ZEF (Chapter 2.4). The results help to make comparisons between different policy alternatives, to evaluate existing policies and to increase sustainability and efficiency of water policy reforms.

One of the key focus areas of the MOSA project were technical water intervention measures, especially in the field of wastewater treatment. Operational concepts adapted to local conditions play a key role for efficient sewerage treatment and help to improve the water quality of the river system of the Olifants catchment. REMONDIS took inventory of the municipal WWTPs in the Middle Olifants catchment area. Based on this survey report, adapted refurbishment programmes and O&M guidelines have been applied in case studies, practical campaigns and training programmes (Chapter 2.6).

A pioneering technology for these refurbishment measures is the HUBER VRM® membrane bioreactor, which has been demonstrated and tested in the project region (Chapter 2.7). When taking inventory of the sewage treatment plants in the Olifants catchment area, it was found that the membrane-technology can bring considerable economic benefits compared to conventional plant refurbishment under certain framework conditions.

Linking the refurbishment measures with the risk assessment tool, the MOSA partners could show the positive effects of the water intervention measures. By reducing the discharge of untreated (or insufficiently treated) wastewater into the rivers the contamination potential of the WWTPs could be reduced significantly (see Chapter 2.1, Figure 2.1-32).

Studies on the value chain for production and services showed mutual benefit of international cooperation for German and South African partners. IEEM also developed strategies for the empowerment of local actors and improvement of local ownership in the region. Furthermore, a sustainable water financing approach that addresses the lack of investment for the water sector has been conceptualised by IEEM (Rudolph 2015) and practical financial tools and investment schemes have been developed to complement and enhance the WWTP refurbishment concept (Chapter 2.5).

The results of the MOSA work packages show applicable solutions for Integrated Water Resources Management both in the project region as well as in other regions and catchments in Southern Africa and beyond. It is in the nature of a research project to show and demonstrate concepts and pilot measures – the next necessary step would be implementation and upscaling by users and responsible institutions.

In addition to the aforementioned implementation activities, further results have been achieved so far:

- The modular MOSA IWRM concept has been transferred to the Lake Victoria basin. The model is used as a framework for the ongoing Lake Victoria Basin IWRM programme (Mwinjaka 2015). The programme funded by a consortium of international development banks started in 2016 with shortlisting of high priority investments and preparation of feasibility studies.
- Moreover, MOSA recommendations and approaches had some influence on the tendered Integrated Water Quality Management Plan (IWQMP) for the Olifants River system, for instance the catchment situation assessment including investigation of potential pollution sources and possible trends or random mobile laboratory sampling as a part of the water quality monitoring programme requirements (DWS 2015b).

- Building on some of the MOSA findings and additional aspects, a research proposal has been developed in cooperation with South African partners (e.g. Kruger National Park and Lepelle Northern Water) for a management system for the Lower Olifants catchment.

3.2 Water loss reduction as an example of efficient water management

From an economic point of view, the MOSA project has shown that there is a strong need for action in the area of water efficiency and efficient management of the scarce resources (e.g. Rudolph 2013; Hilbig & Rudolph 2016) – both water resources and funds for investments.

We will illustrate this shortly through a final calculation example. There is a huge potential for water loss reduction (WLR) in the project region, especially in municipal water supply systems (very high loss rates) as well as in agricultural water use (irrigation is the main water-use sector in the Olifants catchment).

The achievement of a 25 % water loss reduction target in municipal supply systems would have a noticeable impact on the available water resources in the Middle Olifants region. Based on studies by Mckenzie et al. (2012) and the Department of Water and Sanitation (DWS 2014) and indicators of municipalities in the project region[1], we assume a rate of 70 % non-revenue water which corresponds to about 50 % real losses. This is in line with the data available for Mpumalanga. Limpopo is the worst performing South African province in terms of water losses (DWS 2014, p. iii): for 73 % of the municipalities in Limpopo there is no reliable non-revenue water or litres/capita/day data available (Mckenzie et al 2012) – a vast majority of municipalities in the Olifants region does not monitor their water losses and water consumption.

Basing on these figures and estimates, we have come to the following conclusion: a 25 % reduction of water losses in the municipal supply systems of the Middle Olifants region would reduce the physical losses to 37.5 % (still more than ten percentage points above national average physical losses) and results in savings of 4.7m m³/a based on urban/rural use in the MOSA region of 37.5m m³/a. These potential savings correspond to about 12.5 % of the total urban/rural respectively 45.5 % of the total industrial/mining water use in the Middle Olifants region (water use according to the MOSA WRM figures provided by DHI, see Chapter 2.2, Table 2.2-4).

Water loss reduction measures in agriculture will have an even bigger effect, as agriculture is the main water user in the region. “With the agricultural water use sector being the largest of all water use sectors in South Africa, there have been increased expectations that the sector should increase efficiency and reduce consumption” (Reinders et al. 2011, p. 179). A calculation based on conveyancing system losses (does not include efficiency of field application methods) of the Loskop Irrigation scheme

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1 DWS estimates B4 (mostly rural) municipalities’ NRW at 58 % (DWS 2014 a) in contrast to 72.5 % (Mckenzie et al 2012). “These results may well be optimistic given that they are based on those municipalities with data, which are likely to have better control over their water” (DWS 2014, p. iv). Indicators of municipalities in the project region which are providing data show that the NRW rates are at the same high level (e.g. Thembisile Hani Local Municipality spends 68.5 % of its bulk water budget for the audited fiscal year 2013/14 for water losses (THLM 2015)).

shows the potential for water loss reduction. Extrapolating the figures of the LIB (Loskop Irrigation Board, the largest scheme in the region and very well managed) and assuming 5 % water loss reduction for distribution of the total amount of water used by the agricultural sector in the MOSA region to reach the desired range of conveyancing system losses (Reinders et al 2010, p. 10) would result in savings of 8.3m m³/a which correspond to about 22 % of urban/rural respectively 80 % of industrial/mining use.

In other words: successful WLR in municipal supply and agricultural conveyancing systems as just one single aspect of efficient water management would result in savings of up to 20 % of the average water deficit in the Middle Olifants region.

3.3 Conclusion

The findings of the MOSA project highlight the urgent need for efficient action. Broadly spoken, it is not a lack of institutions or a lack of water resources – there is a lack of efficient and sustainable water management. The general problems are known and the first measures have been taken. The implementation of sustainable IWRM measures is a necessary step towards an economic, social and environmental sustainable management of scarce water resources. The MOSA project showed exemplary measures and tools to support these efforts.

Figure 3-1: The water-energy-food nexus: need for efficient and sustainable water resources management
(Irrigation system near Groblersdal, source: IEEM)

References

Backeberg, G.R. (2005). Water Institutional Reforms in South Africa. Water Policy Vol. 7 (1), pp. 107–123.

Balfour, F., Badenhorst, H., Trollip, D. (2011). A Gap Analysis of Water Testing Laboratories in South Africa. Report to the Water Research Commission No. TT 488/11, Pretoria

BMBF funding priority IWRM (2015). [Homepage] http://www.bmbf.wasserressourcen-management.de/en/index.php [Accessed 27/11/2015].

Claassen, M. (2013). Integrated Water Resource Management in South Africa. International Journal of Water Governance Vol. 1 (3-4), pp. 323–338.

Claassen, M., Funke, N., Nienaber, S. (2013). Scenarios for the South African Water Sector in 2025. Water SA Vol. 39 (1), pp. 143–150.

Drucker, P.F. (1963). Managing for Business Effectiveness. Harvard Business Review Vol. 41 (3), pp. 53–60.

DWA – Department of Water Affairs (2013). Business Case for the Olifants Catchment Management Agency. Draft 28 October 2013, Pretoria.

DWS – Department of Water and Sanitation (2014). A 2011/2012 Assessment of Non-Revenue Water & Water Losses in South Africa, Pretoria.

DWS (2015a). Establishment of the Olifants Catchment Management Agency in terms of Section 78(3) of the National Water Act, 1998 (Act No. 36 of 1998). Government Notice No. 168 of 2015.

DWS (2015b). Development of an Integrated Water Quality Plan for the Olifants River System. Bid No. WP 10504, Pretoria [Issue Date 17/7/2015].

Herrfahrdt-Pähle, E. (2010). Introducing Catchment Management. The Case of South Africa. DIE Discussion Paper No. 3/2010, Bonn.

Hilbig, J., Rudolph, K.-U. (2016). Wassereffizienz als Erfolgsfaktor für das Wassermanagement in Schwellenländern. Erfahrungen aus dem Pilotprojekt MOSA, Südafrika. Wasser&Abfall [forthcoming].

Mckenzie, R., Siqalaba, Z. N., Wegelin, W. A. (2012). The State of Non-Revenue Water in South Africa. Report to the Water Research Commission No. TT 522/12, Pretoria.

Mwinjaka, O. (2015). [Presentation] Overview of the Lake Victoria Basin Commission. http://fdmt.iwlearn.org/en/test-folder/10LVBCPPT_LVBC_IWA.pdf [Accessed 07/12/2015].

National Planning Commission (2012). National Development Plan 2030. Our Future – make it work. Executive Summary.

Reinders, F. B., van der Stoep, I., Lecler, N. L., Greaves, K. R., Vahrmeijer, J. T., Benadé, N., du Plessis, F.J., van Heerden, P. S., Steyn, J. M., Grové, B., Jumman, A., Ascough, G. (2010). Standards and Guidelines for Improved Efficiency of Irrigation Water Use from Dam Wall Release to Root Zone Application: Supplementary Information. Report to the Water Research Commission No. TT 467/10, Pretoria.

Reinders, F. B., van der Stoep, I., Backeberg, G. R. (2011). Improved Efficiency of Irrigation Water Use: a South African Framework. ICID 21st International Congress on Irrigation and Drainage, October 2011, Teheran, Iran, pp. 179–194.

RSA – Republic of South Africa (1998). National Water Act. Act No. 36 of 1998.

Rudolph, K..-U. (2013). Mehr Effizienz in der Wasserwirtschaft, in: Mohr, R., Utikal, H. (Eds.): Zukunft Chemie. Perspektiven auf die Welt von morgen. Frankfurt am Main, pp. 144–149.

Rudolph, K.-U. (2015). [Presentation] Sustainable Water Finance. Keynote presentation on the occasion of the Bonn Conference on Sustainable Development Goals: a Water Perspective, 17 to 18 August 2015, Bonn.

Siebrits, R. M., Winter, K., Barnes, J., Dent, M. C., Ekama, G., Ginster, M., Harrison, J., Jackson, B., Jacobs, I., Jordaan, A., Kasan, H. C., Kloppers, W., le Roux, R., Maree, J., Momba, M. N. B., Munnik, A. V., O'Keeffe, J., Schulze, R., Silberbauer, M., Still, D., van Zyl, J. E. (2014). Priority Water Research Questions for South Africa developed through Participatory Processes. Water SA Vol. 40 (2), pp. 199–210.

THLM – Thembisile Hani Local Municipality (2015). Annual Budget 2015/2016 – 2017/2018 Financial Years.

United Nations (2015). Transforming our World. The 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on 25 September 2015, A/Res/70/1.

WWAP – United Nations World Water Assessment Programme (2014). The United Nations World Water Development Report 2014: Water and Energy. Paris, UNESCO.