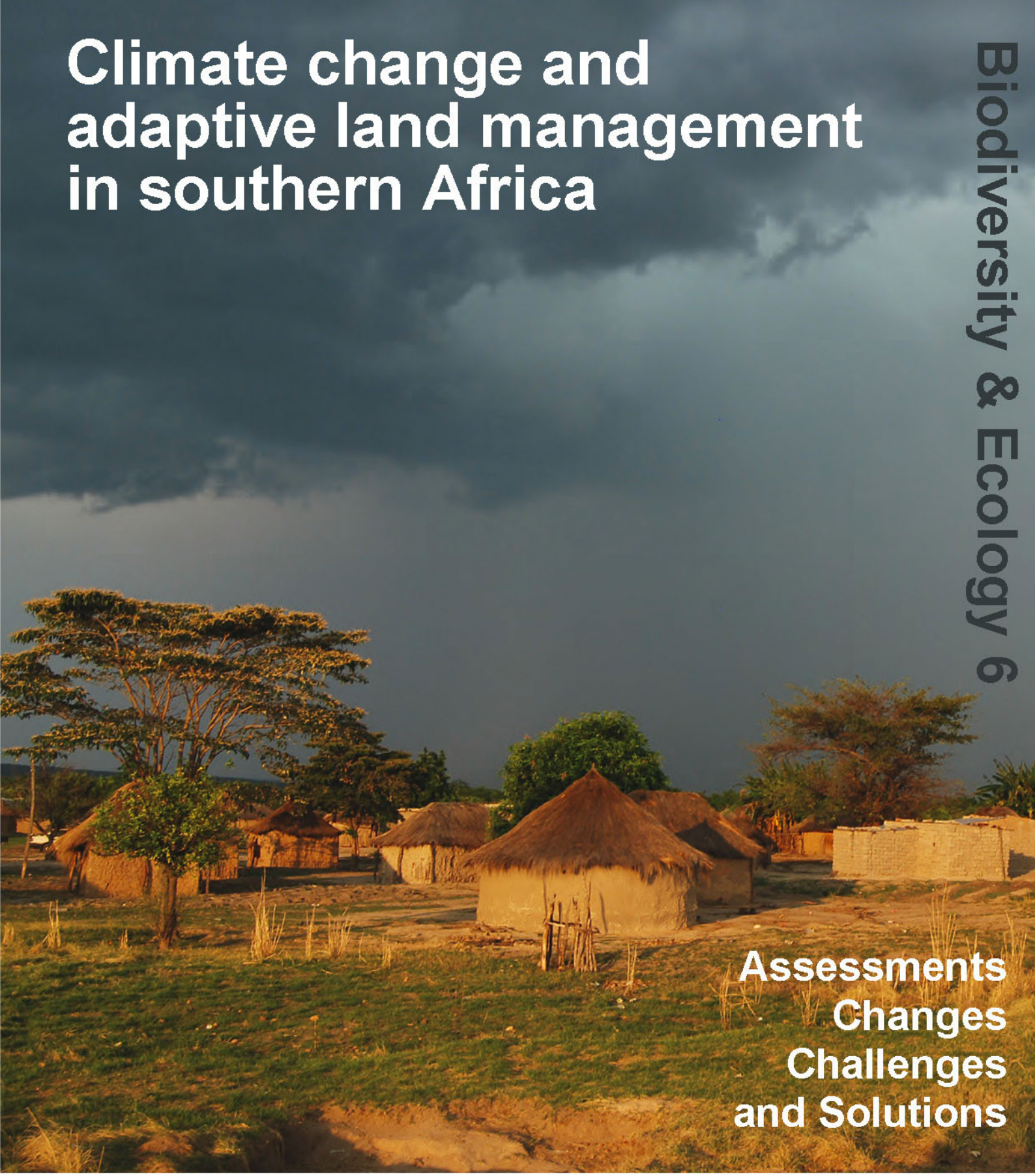
Climate change and adaptive land management in southern Africa

Biodiversity & Ecology 6



Assessments Changes Challenges and Solutions

Product of the first research portfolio of

SASSCAL 2012–2018

Southern African Science Service Centre for Climate Change and Adaptive Land Management

SPONSORED BY THE

Federal Ministry of Education and Research

Klaus Hess Publishers
Göttingen & Windhoek
www.k-hess-verlag.de

ISBN: 978-3-933117-95-3 (Germany), 978-99916-57-43-1 (Namibia)

Language editing: Will Simonson (Cambridge), and Proofreading Pal
Translation of abstracts to Portuguese: Ana Filipa Guerra Silva Gomes da Piedade
Page desing & layout: Marit Arnold, Klaus A. Hess, Ria Henning-Lohmann
Cover photographs:
front: Thunderstorm approaching a village on the Angolan Central Plateau (Rasmus Revermann)
back: Fire in the miombo woodlands, Zambia (David Parduhn)
Cover Design: Ria Henning-Lohmann

ISSN 1613-9801

Printed in Germany

Suggestion for citations:
Volume:
Revermann, R., Krewenka, K.M., Schmiedel, U., Olwoch, J.M., Helmschrot, J. & Jürgens, N. (eds.) (2018) Climate change and adaptive land management in southern Africa – assessments, changes, challenges, and solutions. *Biodiversity & Ecology*, **6**, Klaus Hess Publishers, Göttingen & Windhoek.

Articles (example):
Archer, E., Engelbrecht, F., Hänsler, A., Landman, W., Tadross, M. & Helmschrot, J. (2018) Seasonal prediction and regional climate projections for southern Africa. In: *Climate change and adaptive land management in southern Africa – assessments, changes, challenges, and solutions* (ed. by Revermann, R., Krewenka, K.M., Schmiedel, U., Olwoch, J.M., Helmschrot, J. & Jürgens, N.), pp. 14–21, *Biodiversity & Ecology*, **6**, Klaus Hess Publishers, Göttingen & Windhoek.

Corrections brought to our attention will be published at the following location:
http://www.biodiversity-plants.de/biodivers_ecol/biodivers_ecol.php

Biodiversity & Ecology

Journal of the Division Biodiversity, Evolution and Ecology of Plants,
Institute for Plant Science and Microbiology, University of Hamburg

Volume 6:

Climate change and adaptive land management in southern Africa

Assessments, changes, challenges, and solutions

Edited by

Rasmus Revermann[1], Kristin M. Krewenka[1], Ute Schmiedel[1],
Jane M. Olwoch[2], Jörg Helmschrot[2,3], Norbert Jürgens[1]

1 Institute for Plant Science and Microbiology, University of Hamburg
2 Southern African Science Service Centre for Climate Change and Adaptive Land Management
3 Department of Soil Science, Faculty of AgriSciences, Stellenbosch University

Hamburg 2018

Please cite the article as follows:

Beyer, M., Hipondoka, M., Hamutoko, J. & Wanke, H. (2018) Water resources in the Cuvelai-Etosha Basin. In: *Climate change and adaptive land management in southern Africa – assessments, changes, challenges, and solutions* (ed. by Revermann, R., Krewenka, K.M., Schmiedel, U., Olwoch, J.M., Helmschrot, J. & Jürgens, N.), pp. 84-85, *Biodiversity & Ecology*, **6**, Klaus Hess Publishers, Göttingen & Windhoek. doi:10.7809/b-e.00308

Water resources in the Cuvelai-Etosha Basin

Matthias Beyer[1], Martin Hipondoka[2], Josefina Hamutoko[3] and Heike Wanke[3]*

1 Federal Institute for Geosciences and Natural Resources (BGR), Stilleweg 2, 30655 Hannover, Germany
2 Geography Department, University of Namibia, 340 Mandume Ndemufayo Avenue, Windhoek, Namibia
3 Geology Department, University of Namibia, 340 Mandume Ndemufayo Avenue, Windhoek, Namibia
* Corresponding author: hwanke@unam.na

The Cuvelai-Etosha Basin (CEB), a transboundary river basin shared almost equally by Angola in the north and Namibia in the south, is home to approximately 40% of the Namibian population. The CEB is an endorheic catchment—that is, there is no outflow of surface water from the basin. Reliable supply of fresh water is an omnipresent issue as there is only one rainy season (November–April) with limited rainfall and no perennial rivers.

It receives summer rainfall, with an annual average of 300 mm in the southwest and 850 mm in the northeast (Mendelsohn & Weber, 2011). February and March are the wettest months. Because of a highly variable rainfall in space and time, both droughts and floods are frequent in the basin. The last recorded major floods occurred in 2008–2011, with medium floods in 2012 and 2017. Drought or lean years occurred from 2014 to 2016. The temperature is on average above 23 °C, and the evaporation rate is up to six times greater (over 3,000 mm y-1) than the average rainfall (Mendelsohn et al., 2013).

While the central parts of the CEB are supplied with drinking water pumped from the Kunene River (Angola) via a canal system, groundwater is the main source of potable water in remote areas. Shallow, wide, and anastomosing channels, locally known as *iishana* (sing. *oshana*), are filled with floodwater from Angola during the rainy season and are common features in the central alluvial plains. In "good" years (i.e., years with high rainfall), iishana create an interconnected, gently flowing river system with water eventually reaching Etosha Pan. Iishana provide fresh water for the ecosystem, livestock, agricultural activities, and drinking during and shortly after the rainy season (they generally dry out in less than four months on average). In the sandy regions in the east and west, surface runoff is nearly nonexistent. Ponding water can be found only in pans – depressions that are seasonally filled with rainwater.

In rural areas the main water resource is local shallow aquifers (*perched aquifers*) that occur as discontinuous small water bodies trapped by impermeable layers within the unsaturated zone. Hand-dug (Fig. 1) wells are owned and/or shared by families, and often villages have more than ten wells in one well field. Normally these hand-dug wells are not covered, and surface runoff including waste matter (e.g., originating from cows) can be washed or blown into the wells. Consequently, having several open wells not only promotes overexploitation of groundwater resources but also increases the risk of groundwater contamination, especially for the shallow aquifers. Livestock watering and agricultural activities also utilise groundwater abstracted from shallow (hand-dug wells; <30 m) or deep (boreholes; >50 m) aquifers as well as the above-mentioned surface water ponding during and shortly after the rainy season in local depressions. In Figure 1, a summary of the most important water resources for the local population is provided. Further details are given in Calunga et al. (2015).

High population density, rapidly growing population, and demand for development and infrastructure in rural areas all add pressure on the limited water resources in the basin, and thorough estimates of the available quantity and quality of all water resources are rare. For effective planning and sustainable management of water resources, a comprehensive understanding of the water system through integrated hydrological and hydrogeological investigations is required (Wanke et al., 2018). The results for the deeper groundwater in the study area are documented by Himmelsbach et al. (2018), Lindenmaier et al. (2014), and Wallner et al. (2017).

References

Calunga, P., Haludilu, T., Mendelsohn, J., Soares, N. & Weber, B. (2015) *Vulnerabilidade na Bacia do Cuvelai / Vulnerability in the Cuvelai Basin, Angola*. Luanda: Development Workshop.

Himmelsbach, T., Beyer, M., Wallner, M., Grünberg, I. & Houben, G. (2018) Deep, semi-fossil aquifers in southern Africa: A synthesis of hydrogeological investigations in northern Namibia. This volume.

Lindenmaier, F., Miller, R., Fenner, J., Christelis, G., Dill, H.G., Himmelsbach, T., Kaufhold, S., Lohe, C., Quinger, M., Schildknecht, F., Symons, G., Walzer, A. & van Wyk, B. (2014) Structure and genesis of the Cubango Megafan in northern Namibia: implications for its hydrogeology. *Hydrogeology Journal*, **22**, 1431–2174.

Mendelsohn, J. M. & Weber, B. (2011) *The Cuvelai Basin, its water and people in Angola and Namibia*. Windhoek, Namibia: Development Workshop & RAISON.

Mendelsohn, J. M., Jarvis, A. & Robertson, T. (2013) *A profile and Atlas of the Cuvelai-Etosha basin*. Windhoek, Namibia: RAISON & Gondwana Collection.

Wallner, M., Houben, G., Lohe, C., Quinger, M. & Himmelsbach, T. (2017) Potential groundwater recharge to the confined semi-fossil Ohangwena II Aquifer, Namibia – Inverse modeling and uncertainty analysis. *Hydrogeology Journal*, accepted for publication.

Wanke, H., Beyer, M., Hipondoka, M., Hamutoko, J.T., Gaj, M., Koeniger, P. & Himmelsbach, T. (2018), The long road to sustainability: integrated water quality and quantity assessments in the Cuvelai-Etosha Basin, Namibia. This volume.

Hand-dug wells ("eendungu", deep wells, up to 30 m deep)

Very commonly, well fields in depressions with numerous wells dug by the local communities can be polluted by animal excrement.

Hand-dug wells (shallow wells, up to 5 m depth, funnel-shaped)

Common in the Eastern Sand Zone (both Namibia and Angola), water is trapped on old river beds (clayey), usually protected by fences. Photo: Nils Wölki

Hand pumps

Hand-operated pumps are often present in rural areas. Cheaper than borehole water, the installations are provided by the government.

Boreholes (engine-operated)

Boreholes drilled by the government exist in many areas in the CEB. Usually, a big tank is filled and then water tapped from there. Expensive for most people.

Calueque–Oshakati water carrier

Open channel connecting the Calueque dam with the township of Oshakati. Most important water source in the western Cuvelai. Water is diverted from the canal and provides tap water for the less poor population until Eenhana.

Iishana

Seasonally flooded (by waters from Angola) depressions which are remainders of an old river system. Important water source for livestock watering and grazing (grasses growing there).

Pans

Seasonally flooded pans, mainly in the Eastern Sand Zone. Different from iishana because filled only by local rain. Used for livestock watering during and after the rainy season.

Artesian and subartesian wells

Confined aquifers are present throughout the CEB. In some places (e.g., near Etosha Pan) the pressure is high enough to create artesian conditions. No energy is needed for pumping.

Figure 1: Water Resources of the Cuvelai-Etosha Basin, Namibia