This material is shared as a learning resource to promote awareness and good practice in the provision, use and management of water resources for sustainable social and economic development and maintenance of African ecosystems.

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Potential of Groundwater Exploration for Water Security

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Libreville, 1st November 2018
Water Demand

Projected Population

Source: UN DESA (2017)

GDP in Billion US-Dollar

Source: WEO (2018)

Source: CFAO (2015)
Conventional Water Resources under Stress

Source: IPCC 2014
Conventional Water Resources under Stress

Source: Smakhtin et al. (2003)
Conflicting Use and Trade Offs
Africa‘s Water Resources

Source: UNEP (2010)
Groundwater – the key to water security in the 21st Century?

- Buffer against climatic variations
- Soil acts as a natural filter
- Significant resources that remain untapped

Source: Wada et. al. (2010)c
Groundwater – the key to water security in the 21st Century?

Source: FAO (2013)
Groundwater – the key to water security in the 21st Century?

Source: USGS (2016)
Groundwater – the Final Frontier

• Lack of information about exact dimensions and productivity of aquifers
• Discoveries as result of erratic measurements
• Systematic exploration with a clear strategy required

Aquifer Exploration Techniques
Aquifer Exploration Techniques
Aquifer Exploration Techniques

Source: NiBzH from Wikimedia Commons
Selected Aquifers
East Africa

Paleo Deltas?
Selected Aquifers Sahel

Source: Schneider (1992)
Selected Aquifers Sahel

Artesian zones of Pliocene Inferior

Source: Schneider (1992)
Regional Groundwater Systems
Southern Africa
Aquifer Exploration in Namibia
Cuvelai-Etosha-Basin
Aquifer Exploration in Namibia

Catchment areas of the Cuvelai Basin and adjacent regions
Aquifer Exploration in Namibia
Sedimentary fans in the Cuvelai - Basin
Aquifer Exploration in Namibia

Recharge occurs in Angola

before wet season

after wet season
Aquifer Exploration in Namibia
Aquifer Exploration in Namibia

Source: www.wikipedia.de
Aquifer Exploration in Namibia
Paleo Lakes
Aquifer Exploration in Namibia
Simplified sketch of groundwater structure and conditions

- Local perched aquifers in unsaturated zone
- High salinity aquifer
- Hydraulic separating layer
- Increasing salinity
- Extension, storativity, and yield
- Precipitation 450 mm/a
- Recharge
- Discharge
Aquifer Exploration in Namibia

Okavango Basin

Evapotranspiration from shallow ground water

Evapotranspiration 98%

Outflow 2%

940-900 m.a.s.l.

980-720 m.a.s.l.

Pre-Kalahari Basement

FRESH groundwater

POM

SALINE groundwater

PLM

OD

saline density flow

salt crusts (trona)

f fresh

river / channel / swamp

TDS = 40 ppm

faulting

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

GEOZENTRUM HANNOVER
Aquifer Exploration in Namibia
Okavango Basin – X-Section

Schematic!
Vertically exaggerated

Modified after Meier 2008
Conclusions

• Groundwater can be a vital part of a more climate resilient water supply

• Africa’s groundwater potential is not yet exhausted (with regional differentiation)

• Sustainable resource management requires sound information about its location, renewal and productivity → exploration can fill these gaps
Conclusions

• Move from chance findings to a systematic approach

• Development of exploration strategies that follow strong indications for deep groundwater – Graben and Horst systems

• Significant technical and human capacities to conduct exploration campaigns are required

• Management concepts and water reuse in order to avoid depletion of newly tapped resources
Thank you for your attention!