

# **Developing a GIS-tool for integrated mapping and management of groundwater drought vulnerability and insecurity in the SADC region**

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## **Abstract**

Large parts of the SADC region are drought-prone and potentially strongly affected by increasing climate change and variability. Historic recurrent droughts have caused losses with high numbers of casualties. Groundwater is a critically important water resource in the region, providing access to drinking water for up to 75 % of the population. As part of a wider SADC program on groundwater and drought management, a component aims to map the vulnerability of groundwater towards drought in the region. Groundwater, though inherently relatively resistant to drought compared to shallow surface water bodies, is susceptible to prolonged meteorological droughts. This relates to a direct gradual and physical dewatering of the aquifers as the drought progresses. But groundwater insecurity is often critically exacerbated during droughts in SADC due to human factors, such as poor groundwater infrastructure and management. Therefore, the mapping tool integrates both the climatic and hydro-geological factors (the hazard) as well as the socio-economic vulnerability to derive at aggregated groundwater drought vulnerability and insecurity maps, which essentially depicts the broader risk of groundwater insecurity in the region. The map is developed in an ArcGIS platform based on a composite mapping analysis (CMA), using existing data and maps, partly developed in dialogue with SADC member state representatives working in the water sector. As part of the physical hazard assessment, a meteorological drought index is developed and mapped, based on daily ERA-Interim reanalysis precipitation data from 1989 to present. This is combined with the hydro-geological drought vulnerability (assessed as a weighted combination of aquifer productivity and groundwater recharge potential) to derive the overall groundwater reliability distributed over the region. This groundwater reliability is then crossed with the human vulnerability, which integrates the human capacity level (general development indices and groundwater management capacity) with surrogate data for groundwater dependence (e.g. population and livestock density, irrigation intensity and distance to alternative water sources) to come up with an overall map of groundwater drought vulnerability. Finally, this map is overlaid with current knowledge of groundwater degradation trends (groundwater quality problems and intensive use of groundwater) to arrive at an overall groundwater insecurity visualization. The regional maps are

printable in 1:10.000.000 scale, with a spatial resolution of 10 km in most individual layers. The tool (GIMMS - Groundwater Insecurity Mapping and Management System) is meant to raise awareness on the strategic role of groundwater in the SADC region, particularly related to drought, to facilitate and enhance groundwater management and collaboration at the international as well as national and more local scale, through dialogue based on shared collection, compilation and visualization of data and scenarios. Best options for anchoring the tool with SADC and other entities involved in groundwater management in the region are discussed.