

## USING ICT TOOLS TO PROMOTE THE GOVERNANCE OF GROUNDWATER RESOURCES IN SEMI-ARID AREAS OF SOUTHERN AFRICA: THE STAMPRIET TRANSBOUNDARY AQUIFER SYSTEM

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The Stampriet Transboundary Aquifer System (STAS) area extends over about 87000 km<sup>2</sup> from Central Namibia into Western Botswana and South Africa's Northern Cape Province. The STAS is a low-transmissivity system in which the yield is dominated by withdrawal from storage, and thus the propagation of drawdown to larger distance is slow.

Due to the lack of permanent surface water in such arid area, human activities (mostly related to agriculture) only rely on groundwater and the STAS is particularly vulnerable to overexploitation and pollution. Further to these factors, the lack of a proper monitoring network seriously hampers a systematic analysis of the stresses identified. Within this framework, activities were carried out by UNESCO International Hydrological Programme (UNESCO-IHP) in cooperation with the Governments of Botswana, Namibia and South Africa, within the GGRETA (Governance of Groundwater Resources in Transboundary Aquifers) project, funded by the Swiss Agency for Development and Cooperation (SDC; UNESCO-IHP, 2016).

The major purposes of the GGRETA project is to enhance cooperation on water security, prevent water-use conflicts and improve environmental sustainability. During the first phase of the project, an in-depth assessment about the importance and vulnerability of the STAS was undertaken. This was done by collecting, compiling and analyzing relevant data from different regional and national sources which were then structured into tables, thematic maps and databases. This information has been harmonized to provide a regional outlook on the status of the STAS and to support the establishment of a Multi-Country Cooperation Mechanism (MCCM) for its management and governance. The establishment of the STAS MCCM would be the first example in Southern Africa.

The joint development of a numerical model is crucial to foster such cooperation as it provides a baseline for the formulation of sound policies for the governance of the STAS. The model is being developed through the application of the FREEWAT platform, developed within the H2020 FREEWAT project (FREE and open source software tools for WATER resource management, [www.freewat.eu](http://www.freewat.eu); Rossetto et al., 2015). FREEWAT is a free and open source,

GIS-integrated modelling environment which integrates spatially distributed and physically based codes for the simulation of the hydrologic cycle aiming at facilitating water planning and management. FREEWAT applicability is demonstrated by running 14 case studies, including the STAS, and enhancing participatory approach and evidence-based decision making in water resource management.

Thanks to the involvement of UNESCO-IHP within the FREEWAT Consortium, the model implementation is fully supported through the coordination and integration of research outcomes from the GGRETA project and from previous modeling applications. The STAS model, indeed, was developed adapting an existing model of the Namibian part of the aquifer, where the STAS was discretized using rectangular cells about 40 km<sup>2</sup> wide and a stack of three aquifers and three aquitards with variable thicknesses and heterogeneous hydraulic properties. The model was then extended to Botswana and South Africa and boundary conditions and hydrologic stresses (i.e., rainfall infiltration and abstraction for irrigation purposes) were re-defined.

The STAS model construction will help achieving a state-of-the art representation of the STAS based on available data, forecast dynamics and possibly highlighting any existing knowledge gaps. This will strengthen capacity on groundwater governance at the national and transboundary levels through supporting the process of establishment of the MCCM, thus harmonizing cooperation among the three counties for development of joint strategies for the protection of current and future status of the STAS.

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### References

Rossetto, R., Borsi, I., Foglia, L. (2015) - FREEWAT: FREE and open source software tools for WATER resource management, Rendiconti Online Società Geologica Italiana, 35, 252-255.  
UNESCO-IHP (2016) – Stampriet, Transboundary Aquifer System Assessment – Governance of Groundwater Resources in Transboundary Aquifers (GGRETA), Phase 1 – Technical Report, 168 pp.

