Applied Research Partnerships with Developing and Transition Countries

Swiss Universities of Applied Sciences and Universities of Teacher Education

Foto: Daniel Pittet

Project title

Hydrogeological investigation of the Nubian Sandstone Aquifer System in Northern Chad, baseline study for sustainable management

Thematic focus

Groundwater resources sustainable management

Year

2012

Project location

Chad

Swiss Institution

Scuola Universtiaria Professionale della Svizzera Italiana
Université de Neuchâtel

Partner Institution

University of N'Djaména
Ministry of Water and Hydraulics of the Chad Republic

Description

In the area of North-Eastern Chad there are several lakes and areas of shallow groundwater with palm tree plantations and a high biodiversity. A severe water table decline could generate environmental and agricultural problems as already observed in the Kufra oasis, threatening food security. To develop a controlled and regulated exploitation, a conceptual model of the dynamics of the Nubian Sandstone Aquifer System (NSAS) must be developed. Additionally, without a state of the art situation regarding existing and functionality of water points, it is difficult for the Chadian Water Authority to identify the requirements in terms of water supply for the population living in Northern Chad.

Acquiring high-precision altimetric water points data, hydraulic gradients definition and physico-chemical and isotopic signatures from approximately 200 water points spread in the Nubian Aquifer System of Northern Chad will enable the design a simple semi-quantitative conceptual model on the character of the fossil underground water and will give significant insights on the development of the system in terms of exploitation.

Development relevance

As stated in the Millennium Development Goals, redefined in Johannesburg in 2002, by 2015 the proportion of people that do not have access to drinkable water or that do not possess the means to acquire it, has to be reduced by half. To meet this goal, the Chadian Director Plan for Water and Sanitation defines 3 strategic axis: 1) improvement of knowledge on water resources through research and monitoring networks

2) building national capacities to ensure the sustainable exploitation of water resources, and 3) strengthening of the legislation related to the exploitation of water resources.
In 1999 Chad Joined the Authority of the Nubian Sandstone Aquifer System, created to enhance cooperation in managing its water resources.

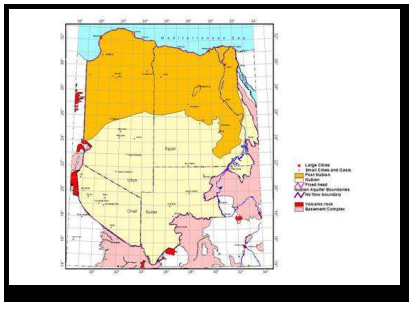

Figure 1 NSAS distribution across Chad, Lybia, Egypt and Sudan.

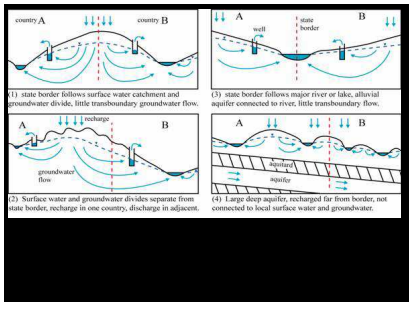

Figure 2 Transboundary issues on groundwater management.

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Main features of the project

Despite the importance that transboundary aquifer system represent, particularly in arid and semi-arid climates where underground water is often the only source of water, the state of knowledge regarding the resource is still to be improved. A sound management of transboundary aquifers assumes enhanced knowledge regarding the resource, the users and the needs for action planning, the follow up of the implementation and the evaluation of the effects. Today, the management of transboundary aquifers clashes against the lack of data, information sharing and control. The existing developed technical and legal framework for international management of watersheds is poorly developed or still lacking for groundwater resources. To achieve a proper regulation, characteristics of aquifers and its dynamics must be considered across borders. Transboundary, in political distribution, of fossil non-renewable groundwater, is a factor which imposes special conditions and particular constrains on resource management, but without reliable hydrogeological data, the understanding, and in a further step, the forecast of the impact of the use of such a resource, is an impossible task.

The goal of the project is to support the management of NSAS by improving its knowledge in its Chadian extent. Through a field-based hydrogeological approach, including the following tasks: 1) survey of available water points of the BET region, including highly-precise altimetry, technical data of water points construction, productivity estimation, water analysis (physico-chemical and isotopic signatures); all data will feed a GIS database, essential tool for analyzing geographical information; 2) a state of the art description including validation of historic data; 3) evaluation of the recent trends, if measurable, of the hydraulic head of the NSAS, considering areas where the aquifer is confined and areas where it is unconfined; 4) semi-quantitative conceptual model of the groundwater flow system of the Nubian Aquifer in its Chadian meridional sector, including issues related to identified areas of recharge, the identification of the groundwater divide and the interaction of groundwater with surface water and the neighboring formations; the model will provide information on estimated quantities of renewable water and therefore will permit to estimate the amount of abstraction that can be withdrawn without severely impacting the groundwater resource; 5) elaboration of guidelines and recommendations for the implementation of a groundwater network monitoring system for NSAS in Northern Chad.

Chad groundwater management is crucial. Particularly in the northern regions where an arid to hyper arid climate prevails (with a mean annual rainfall of 5 mm) and where, besides dates plantations, the agricultural production is entirely dependent on irrigation. Although extraction in relation to the volume stored in the NSAS might be low (total reserves 5.4*105 km3 from wich 0.15*105 km3 available for exploitation), signs of over-extraction have been described. The Great Man-Made River Project, for example, has led to reduced water levels in Libya´s Kufra sub-basin and has dried up lakes linked to oases. Water levels also declined in Egypt's Kharga Oasis by 60 m from 1960 to 1998. In the north of Chad, groundwater level declines have led to a migration of the rural population (www-naweb.iaea.org). However, no information has been found to indicate that this is a transboundary impact of Libya's groundwater development. Population growth in the riparian countries is certain to increase water demand and will contribute further to already existing over-extraction of groundwater from the NSAS.

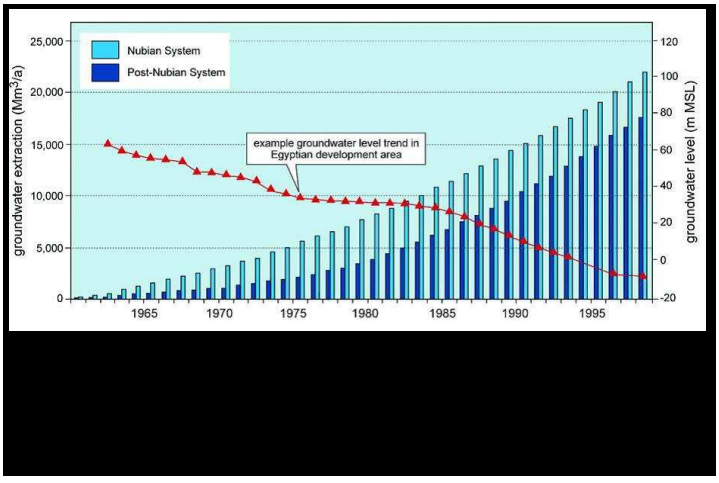

Figure 3 water abstraction from NSAS and groundwater levels evolution.

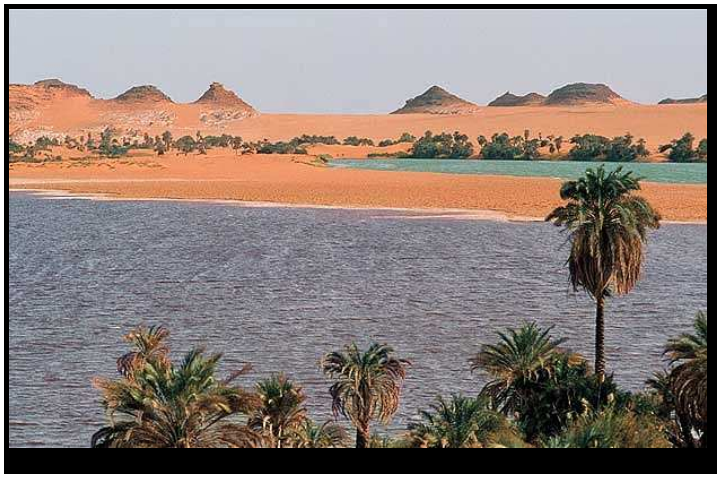

Figure 4 Ounianga Lake, Chad