World Geothermal Congress 2015
Melbourne, Australia, 19-25 April 2015

Management of a Transboundary Low Enthalpy Geothermal Aquifer Basins, Case Study of Continental Intercalaire Aquifer of the North Sahara Aquifer System (NSAS)

Aissa Agoun

Regional Commissariat for Agricultural Development Water Resources Department,

C.R.D.A Kébili, Kébili 4200, TUNISIA

aissa_2503@yahoo.fr

Keywords: NSAS, Continental Intercalaire, OSS, vulnerability

ABSTRACT

The North Sahara Aquifer System (NSAS), shared by Algeria, Libya and Tunisia has reserves of water, which are non renewable, however little and are not exploited in full. Over the past thirty years, the drilling operations by the system as a whole rose from 0.6 to 2.5billion m3/year. This farm is now facing many risks mainly increase on water salinity, the reduction of artesian by drawdown, the drying up of outlets, piezometric interference between countries sharing the system, The simulations on the model NSAS have highlighted the most vulnerable areas. They also identified new areas of potential tax at a lower injury. The results of this detailed knowledge of the basin hydrogeology are a mapping of aquifers for the realization of the mathematical model. The Sahara basin is a large entity layered sediment. The adoption of a simultaneous representation of all segments: water and semi-permeable, can reflect the linkage and hydraulic and chemical exchanges between all layers of the basin, and thus the behaviour of the medium and long term.

A study conducted by the three countries with the contribution of SS0 (Sahara and Sahel Observatory), provides a rather optimistic view of the exploitation of water in the Septentrional Sahara as long as it takes into account together the observations and results model and that the account now has all the risk factors identified by the study. The North Sahara Aquifer System under the SSO. To the extent that mutual information strengthens solidarity, we can design the model of NSAS as a powerful educational tool and an instrument of dialogue and mediation goal, around which dialogue can be organized.

At present, estimates of annual water extraction from this basin amount to 540 km3 in Tunisia, 1,100 km3 in Algeria and 250 km3 in Libya. Tunisia holds an even bigger reserve of exploitable non-renewable groundwater than its neighbors Algeria and Libya with estimates in the order of 1,700 km3 (OSS, 2004).

1. INTRODUCTION

The NSAS extends over a surface area of 1.000.000 km^2 with 700.000 km^2 in Algeria, 250.000 km^2 in Libya and 80.000 km^2 in Tunisia. This basin is located in an arid zone with rainfall ranging from 20 to 100 $mm \cdot yr^{-1}$.

Exploitation of water resources of the system has seen a notable increase during the second half of the 20th century. The yearly abstraction was 0.6 billion m^3 in 1950 then increased to 1.7 Bm^3 in 1970 and reached 2.5 Bm^3. This situation is reflected by the following impacts:

- a notable decrease of artesianism,
- drying of the main springs,
- generalization of pumping abstraction with increasing drawdown,
- degradation of water quality in some areas more vulnerable to salinisation (Chotts areas)

Figure 1: Map showing major basin features and approximate boundary of the NSAS

The mathematical simulations model carried out on the NSAS have highlighted the most vulnerable areas. They also identified new areas of potential lower levies injury.

This is the culmination of a process of synthesis of available information, based on the acquisition, analysis and synthesis of hydrogeological data; development of the common database and geographic information systems; the development and operation of NSAS mathematical model simulating the hydrodynamic behavior of the system; and setting up a consultation mechanism for joint management of the basin.

2. VULERABILITY OF THE NSAS

The North Sahara Basin (figure 1) extends over much of Algeria (700.000 km2), Libya (250.000 km2) and Tunisia (80.000 km2) and is an arid region with rainfall ranging from 20 to 100 mm·yr-1. The majority of the 4 million people living in this basin depend on groundwater resources for its water needs. In 2000, The North Sahara aquifer system (NSAS) supplied an estimated volume of 2.2 billion m3 fresh water for domestic water supply, agriculture and other industrial purposes. Groundwater withdrawal from the NSAS increased from about 14 m3/s in 1950 to 82 m3/s in 2008, resulting in decrease in the natural water flows (OSS, 2003). As groundwater abstraction increases, the need increases for more precise hydrologic data to help refine management decision tools/models on water use. As a consequence, the three countries sharing the system are endeavouring to improve the state of hydro-geologic knowledge for sustainable management of their shared groundwater resources. The purpose of this technical progress report is to document the current knowledge of the NSAS based on recent results of investigations as well as to highlight important information needs that need further investigation.

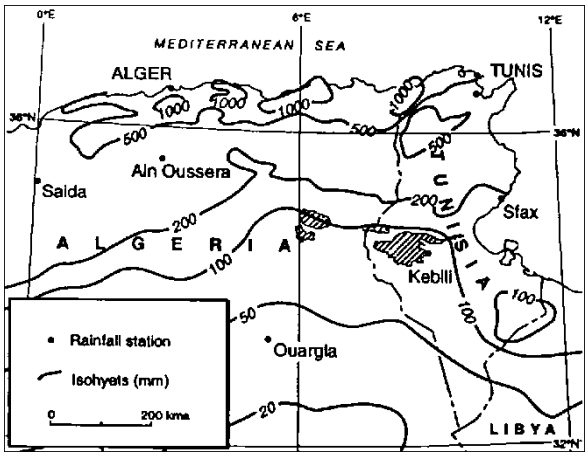

Figure 2: Rainfall over the North Sahara basin and its surroundings

3. AWARENESS

The intense development of the exploitation of aquifers of NSAS has profoundly changed the vision that we can now make this operation, which faces a number of major risks simply because of its development: strong interference between countries, water salinization, loss of artesian, drying up of outlets, excessive pumping heights. The three countries concerned by the fate of the system are therefore constrained in the short term, to seek some form of management of the saharien basin. The leaders of three countries were well aware of these risks and decided to undertake a major program of joint studies; including project management and research funding have been assigned to the OSS. In 1998, with the help of the three countries, the OSS has gained the support of the Swiss Cooperation, IFAD and FAO for an initial three-year phase that continued until December 2002. A second phase between 2003 and 2010, mainly financed by the GEF, FFEM and the Swiss cooperation has improved the vision of the hydrodynamic behavior of the aquifer system, starting the analysis of socio-economic and environmental better realize the mechanism between the three countries. The objectives and activities of the project SASS have a starting point for mastering the knowledge of the behavior of the aquifer system and the impacts of the use of its water resources. Thus, several aspects have been addressed to provide reliable decision support both on the hydrogeology of the aquifer system at the level of information on water uses. A prospective approach using the mathematical modeling of system operation and monitoring of specific indicators both hydraulic socio-economic and environmental, is adopted in order to better strengthen the dialogue for a shared strategic management.

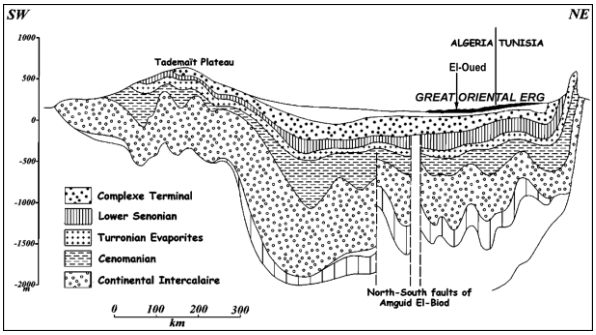

Figure 3: Geologic cross section along North Algeria- Tunisia transect

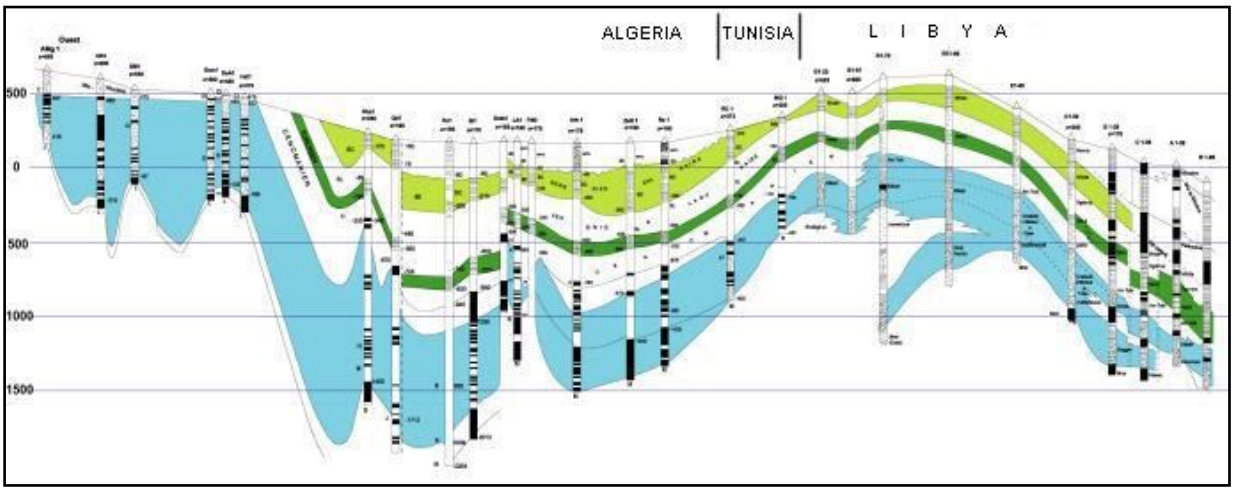

Figure 4: Geologic cross-section along the West (Algerian Atlas)-East (Libya) transect. Blue color shows the CI, White and green band shows the CT (OSS,2003)

4. SUSTAINABLE MANAGEMENT OF NSAS

The analysis of aspects related to water uses in different sectors of human activity in the basin has helped to emphasize that all development activities in the three countries are based on the exploitation of water resources of the SASS. In a largely arid environment, the water is practically the only one available to meet the water supply, irrigation, tourism and industry. It will also help to under the oasis, a certain environment which revolves around a rich biodiversity and varied This exploitation of water resources of SASS, more intensive and competitive, even beyond the availability of renewable aquifer system, is responsible for reactions in both the visible behavior of the aquifer system than the community of use, particularly agricultural land. Thus, some risk of degradation and deterioration has emerged and need to be controlled. At this term hydrogeological model is designed as a basic tool to obtain information to aid the decision of planning between the three countries.

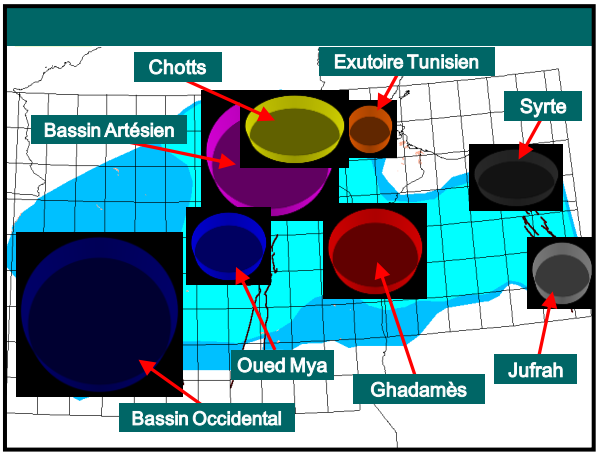

Figure 5: Critical areas of NSAS

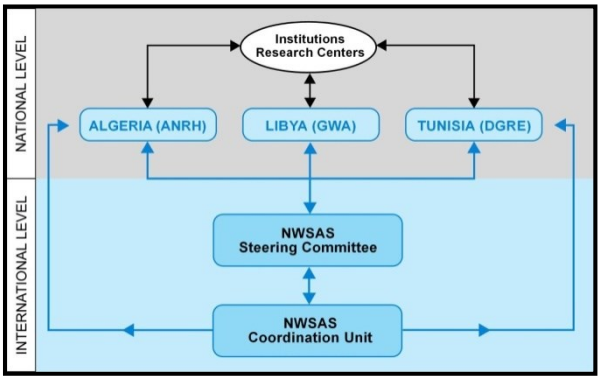

Figure 6: Institutional arrangements for the evaluation and management of the transboundary North –West Sahara Aquifer System

5. CONCLUSION

Groundwater aquifer system of the Northern Sahara is subject to constraints that limit the ability to exploit their potential. These constraints have an economic nature, but the environmental risks are now the most important. Thus, with a thorough knowledge of the hydrogeology of the region, the formation of a common database to develop the mathematical model and at the end of simulations, the results of the project show that the simple continuation of current tax rates can be a serious danger to the Complexe terminal aquifer in the region chotts; outside the chotts region, the outlet of Tunisia and the Gulf of Sirte, slight increases in operating speeds can be supported without major damage; simulations based on strong assumptions lead to an unacceptable situation; there is a possibility of increasing the current levy, but at the cost of relocation of pumping additional fields to remote locations: Grand Erg Occidental, confines of Erg Oriental.

ACKNOWLEDGEMENT

Many thanks to OSS team and SASS experts for his helps

REFERENCES

SASS (2002): Système Aquifère du Sahara Septentrional : Gestion commune d'un bassin transfrontière. Rapport de synthèse. OSS ; 129p.

UNESCO (ERESS): Étude des Ressources en Eau du Sahara Septentrional. Rapport final, 7 plaquettes, UNESCO, Paris UNESCO (United Nations Educational Scientific and cultur organisation.

UNESCO (ERESS) (1970) : Synthèse hydrogéologique préliminaire de la Nefzaoua; 17p.

Dreyfus A., (1968) : Considérations générales sur la structure profondes du sud tunisien; 4p.