Tools for the management of large transboundary aquifers: OSS experience

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ABSTRACT

The focal area of the Sahara and Sahel Observatory (OSS) is located in the Sahara and Sahel zone which contains large sedimentary basins covering each a surface of several hundreds of thousands of km². OSS promotes the concept of "basin awareness" by encouraging the countries sharing transboundary basin to work together in order to manage the groundwater resource in a rational manner. This was experimented in the North Western Sahara Aquifer System (NWSAS), shared by Algeria, Libya and Tunisia, and the Iullemeden Aquifer System (IAS), shared by Mali, Niger and Nigeria. The key element of this management is the consultation based on the development of decision making tools: Database, Geographic Information System (GIS) and Model. In this context, data and information were collected, treated, harmonized and then gathered into a common database, associated with a Geographical Information System (GIS) which supply the groundwater model. Layers of the (GIS) consist of treated and homogenized thematic maps (topographic, hydrogeological, etc.). The development of models enabled the countries to build forecasting simulations for optimal and rational management of the shared resource. The development of all these tools contributed in updating the aquifers knowledge, improved the exchange and strengthened cooperation between countries.

Key words: Data base, GIS, model, aquifer

1. INTRODUCTION

The aquifers of the large shared basins of OSS area contain considerable reserves of fresh water estimated at 1 to 75 thousand billion m^3 per basin (Margat, 1992). Studies were undertaken and others are still ongoing on some of these basins (Fig. 1). OSS plays a role of facilitator between the countries in encouraging them to dialogue in order to manage the resource in an optimal and rational way. The adopted approach consists in developing common decision-making tools (models and data bases), which justify setting up a consultation mechanism between the countries, having for role, amongst other tasks to perennialize the assets. This reflexion is based on the results of SASS and SAI projects.

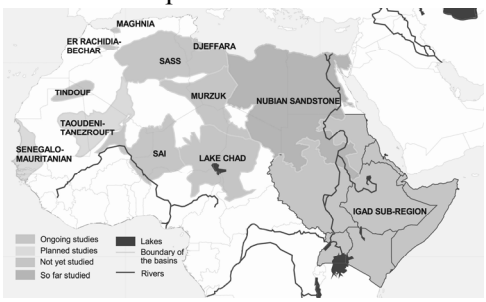

Fig. 1: The large shared basins in OSS area

2. OBJECTIVES

The objectives of these studies consist primarily of the actualization of knowledge by setting up common tools for the shared resource management; and setting up a consultation mechanism between the countries.

3. METHODOLOGICAL APPROACH

3.1. The Databases and Geographical Information Systems

The methodology adopted for setting up of SASS and the SAI Databases are mainly based on: the separation between structure of data (stable element) and treatments (dynamic aspects); and the description of the system at three levels (conceptual, organisational and physical) allowing to progress methodically in the comprehension of the problem and to propose the solutions adapted to the context (OSS, 200à; OSS, 2007a). On the organisational level, an adequate diagram of exploitation in conformity with the internal organization of the national administrations (ANRH, DGRE, GWA) must be defined (Fig. 2). Procedures and rules of exploitation and administration of the system must be elaborated. The Geographical Information System (GIS) plays a significant role in the system set up as it is used at each stage during data treatment and helps to develop thematic maps.

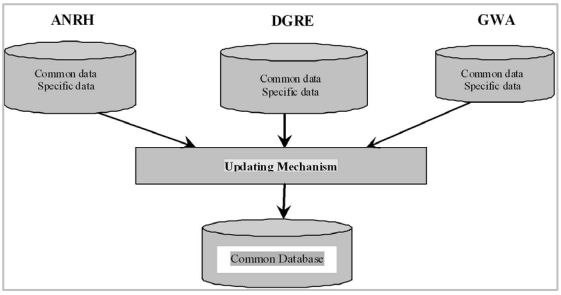

Fig. 2: Organisational solution considered for SASS Database

3.2. The models

The model facilitates the comprehension of the studied system and enables to make forecasts. In a more precise way, the global objective of the modelling carried out within the framework of the OSS projects is the actualization of knowledge. We distinguish three stages in the process of modelling: i) the conceptual stage which consists of describing and specifying the phenomena which will be taken into account in modelling; ii) the mathematical stage corresponds to the transcription in the form of equation the phenomenon describes in the conceptual phase; iii) the numerical stage corresponds to the numerical resolution in a computer code of the equations established at the mathematical stage.

4. RESULTS

The models enabled to understand the hydraulic behaviour of the studied systems and are used as decision-making tools for the rational management of the water resources. The OSS experience in the field of modelling, acquired within the framework of SASS (OSS, 2002b) and SAI (OSS, 2007b) projects, enabled to instigate the use of modelling for groundwater management and to implement capacity building sessions in the countries. The groundwater abstraction scenarios defined by the countries and explored in the model of the SASS enabled to identify the risks zones and to agree on a permanent monitoring piezometric network. The set up of a mechanism of dialogue aims to perennialize the assets through a periodic updating of the developed tools (database and model).

5. DISCUSSIONS

One of the innovations of SASS project is not to consider the mesh as the elementary entity of entry of the data for the digital model. It is at the water point that quantitative information of abstraction, piezometry are linked… and it is at this level that the user carries out the modifications.

Gathering data and totals by mesh are carried out by means of queries executed automatically during the preparation of the data for the model. Thus, the changes of the parameters of the grid do not constitute any more a constraint. This vision allows a better flexibility but requires that a permanent connection be established between the data base and the GIS so that any modification on the water points is reflected immediately and in a transparent way to the level of the data by mesh. A form was elaborated to carry out these operations of connection and to ensure the synchronization Database-GIS-model (Fig. 4).

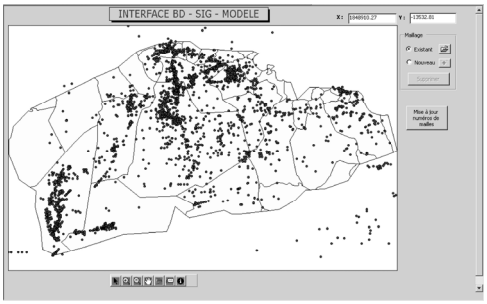

Fig. 4: Interface BD-GIS-Model

6. CONCLUSION

The installation of the data bases of the SASS and the SAI enabled to gather and make homogeneous the whole information available on these two basins in coherent relational structures. Without such opened architectures, it would have been difficult to carry out all the treatments, queries and thematic maps which these projects have produced.

In the field of modelling, the development of the hydrogeologic models led to significant progress regarding water resources management. Their use for better knowing the hydraulic behaviour of the aquifer systems is in full rise and becomes essential. The development of the technical tools undertaken within the framework of the OSS projects led to the installation of a framework of dialogue between the various stakeholders (OSS and representatives of the countries) which is maintained for their regular updating. OSS will continue its role of development coordination at the scale of the basins, which none of the countries can do alone.

7. AKNOWKEGMENTS

I acknowledge here all the OSS water team and all experts who worked with us in the framework of SASS and SAI projects.

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