QUANTITATIVE AND QUALITATIVE HYDROGEOLOGICAL STUDY OF THE ALLUVIAL AQUIFER OF SOMES-SZAMOS (RO-HU) NATO SfP PROJECT 973684 SQUASH

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ABSTRACT: *Started in January 2000, this project was ended in July 2004. Most of the foreseen objectives are reached. A full trans-boundary data-base of groundwater information concerning the studied region has been developed. Many end-users consisting in state-owned organizations and private companies, all of them being directly concerned by groundwater use or supply, have been involved in the project. A common regional groundwater flow numerical model has been built and calibrated on historical data. Solute transport models simulating local groundwater contaminations have been developed. A very positive scientific and technical collaboration exists now between project partners and the dynamic of the project is inducing the exposure of young scientists to the international scientific community. A final workshop was held in June 2004 in Cluj-Napoca (RO) with all end-users and decision makers from Romania and Hungary. All the technical results of the project were discussed and advances have been announced by decision makers for a better management of the groundwater resources in the Somes-Szamos basin; extension to other basins is under consideration.*

Key words: transboundary aquifer, database, regional model, solute transport, groundwater management.

1. Introduction

Groundwater represents about 65% of Europe's drinking water. An aquifer system can underlie different political entities, with its discharge area in one of them, recharge areas in others, and abstraction all throughout its basin extent.

The development of transboundary groundwater resources has generated, and will continue to generate, acrimony among states, nations and provinces. But groundwater resources can also promote peace and accomodation, as jurisdictions and decision-makers, who share a common groundwater resource realize that cooperation is the only way to ensure resource protection and sustainability.

The Somes-Szamos aquifer, which extends on both sides of the Romanian-Hungarian border (Figure 1), supplies drinking water to a population of about 395.000 inhabitants in Romania and 50.000 inhabitants in Hungary.

The research project named SQUASH (for Somes/Szamos Quantitative/Qualitative Study of the Hydrogeology) carried out by a group of

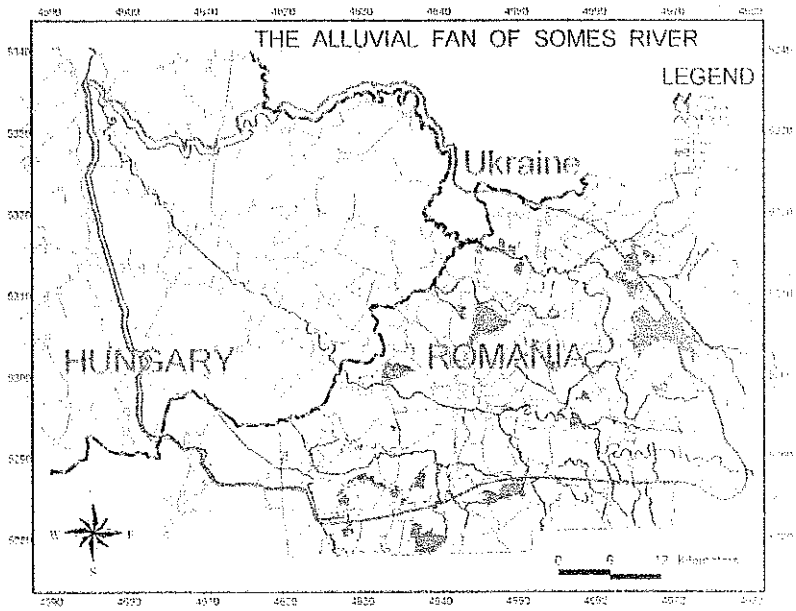

Fig.1 Location of the Somes/Szamos aquifer in Romania and Hungary.

teams formed by Belgium, Romanian and Hungarian partners, in the scope and supported by the NATO Science for Peace programme, was intended to develop common tools and guidelines for local end-users (water supply companies and regulatory authorities from Romania and Hungary) in order to be able to manage the groundwater quantity and quality. The project focused on improving the previous understanding of the groundwater conditions including flow and pollutant transport across many scales, using data acquisition techniques and computer simulation models.

2. Summary of objectives

The main objectives of the project were:

- make possible a sustainable and integrated management of the regional groundwater resources;
- develop scientific and technical collaborations, including young scientists, solving common challenges (GIS-models, tracer tests, ...up-to-date methodologies);
- develop common tools and methodologies to manage cross-border resources leading to a collaboration regarding protection and sustainable use of the aquifer;
- set the basis for long term groundwater monitoring in the border region;
- assess impact of human activities on groundwater quality, main threats to groundwater quality, to prevent further deterioration of groundwater quality

Some additional or secondary objectives were not less important:

- introduce young scientists from Hungary and Romania to the International Scientific Community;
- provide guidance for restoring the ecological protected zones and wetland water levels;
- help end-users and decision-makers to solve local groundwater quantity and quality problems;
- provide information on the scientific results to the public, decision-makers and experts.

3. Description of the different steps /task

The main steps/tasks of the project (Figure 2) were:

1. Collecting all existing data;
2. Building and development of data-bases;
3. New measurements campaigns;
4. Regional modelling;
5. Groundwater quality studies in pilot zones.

Table 1 provides a schematic outline of the timetable of the project activities.

Although the project was approved for three years (2001-2003), in fact it was extended with 6 months in order to allow its implementation. A brief description of the different activities/tasks is presented below:

Task 1 - Collecting all existing data concerning:

a) Groundwater quantity:

- geology (thickness and lithology) of the concerned layers;
- hydrogeological parameters (hydraulic conductivity, storage coefficient);
- piezometric levels as a function of time in the whole basin;
- 'stress-factors' (pumping, recharge, infiltration, irrigation).

b) Groundwater quality:

- hydrodispersive parameters;
- concentration levels for the main pollutants;
- 'stress-factors' (diffuse and point contamination sources).

Task 2 - Building and development of data-bases

After adopting a common data base structure based on the database developed by the Hydrogeology Group of the University of Liège, each team was in charge to feed the data-base with all collected data. The data-base, linked to GIS, insures a perfect compatibility for data exchanges.

Task 3 - New measurement campaigns

On the basis on the analysis of the available data, new campaigns of measurements were carried out focusing the following aspects:

- piezometric levels;
- pumping tests for hydrodynamic parameters;
- groundwater quality campaign (sampling + analysis);
- tracer tests for assessment of transport parameters (locally);
- isotope measurements for groundwater dating.

The priority was given to measurements in areas with low density of observation wells, in order to prepare ideally all the needed data allowing a reliable groundwater modelling (task 4).

Task 4 - Regional modelling

One regional groundwater mathematical model was developed based on all the available data (pre-processed using GIS/data-bases). It represents one of the most important outputs of the project. The groundwater model (GWM) and the data-base coupled to GIS integrate all the available data and the new knowledge about the studied aquifer system. They allow a better evaluation of groundwater resources and a sustainable management of these resources.

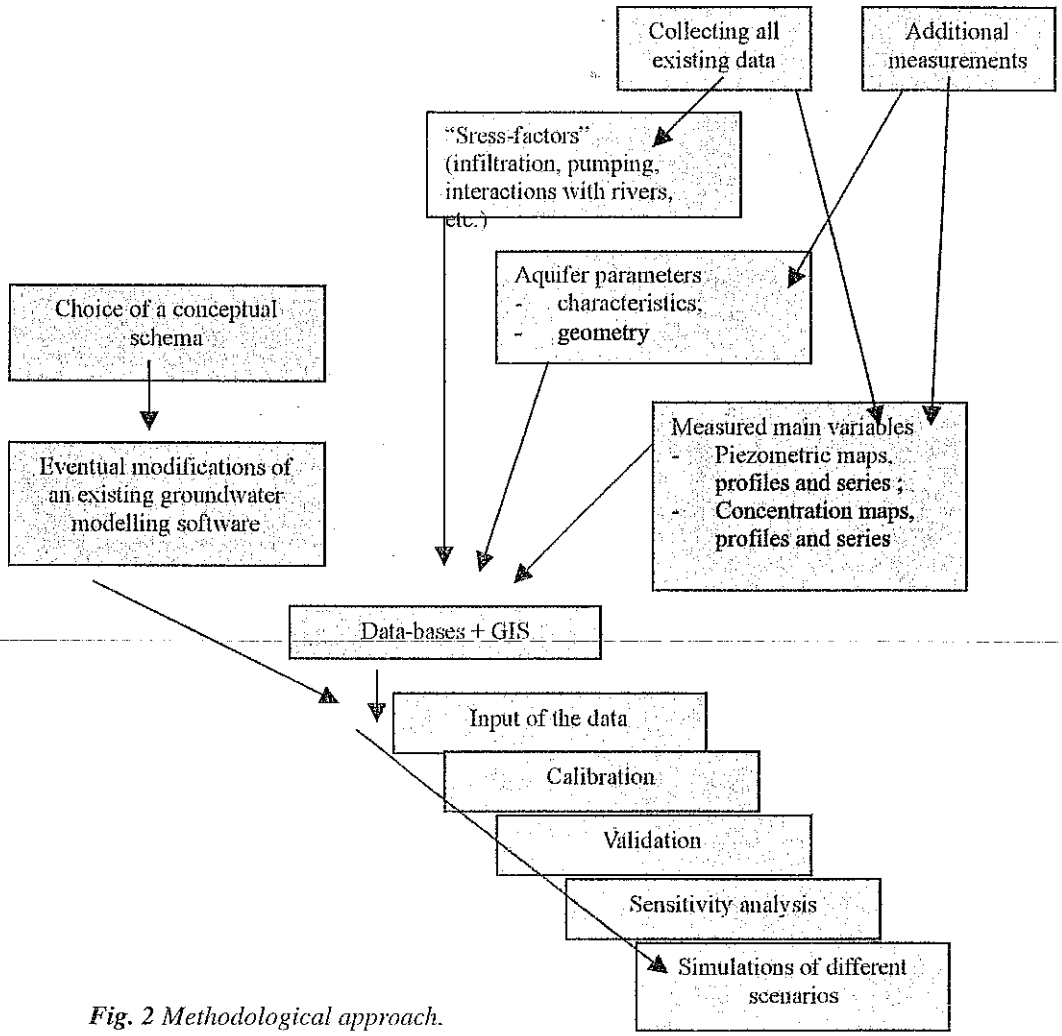

Fig. 2 Methodological approach.

Table 1 A schematic outline of the timetable of the project activities.

	year 1								year 2								year3							
1. Collecting data																								
2. Data-bases																								
3. New measurements																								
4. Regional modeling																								
5. Groundwater quality																								
Training																								
Reporting																								
Dissemination																								
Workshop																								
Web-site																								

Calibration of the hydrogeological parameters was performed in steady-state and in transient conditions. After a sensitivity analysis and a validation procedure, the mathematical model was used to simulate different scenarios for the future. These scenarios were decided in consultation with the end-users and decision-makers (changes in pumping rate, irrigation, drainage etc.).

Task 5 - Pilot studies of groundwater quality at local scale

Locally, some groundwater quality problems were observed or foreseen in the basin. Based on available geological data and results from chemical analyses of the samples taken during the last field campaign, local groundwater transport models were developed. For each site, the boundary conditions were deduced from the regional flow model. The flow conditions were re-calibrated at the local-scale, while the transport model was calibrated based on the maps of the concentration. As required for protection zones delineation, transport times were calculated to the main concentration of pumping wells.

4. The actors of the project

The responsible institutions and the project directors were:

- University of Liège (Ulg), Belgium, Hydrogeology Group, Geomac Department, Applied Sciences, prof. dr. ir. Alain Dassargues (NPD - NATO Project Director);
http://www.hggeomac.ulg.ac.be
- University of Miskolc (UofM), Hungary, Miskolc Egyetem, Dpt of Engineering Geology and Hydrogeology, prof. dr. László Lénárt (PPD - Project Partner Director);
http://www.illit.hgeol.gold.uni-miskolc.hu
- Technical University of Civil Engineering Bucharest (TUCEB), Romania, Department of Hydraulic Structures and Water Resources, prof. dr. eng. Radu Drobot (PPD - Project Partner Director); http://www.utcb.ro.

The end-users of the project were technical and administrative bodies from both countries:

- National Institute of Hydrology and Water Management NIHWM (Institutul National de Hidrologie si Gospodarirea Apelor - INHGA), Bucharest, Romania ;
- Public Utility of Satu-Mare (Regia Autonoma Comunala Satu-Mare - RAC Satu-Mare), Romania;
- Council of the Satu-Mare County (Consiliul Judetean Satu-Mare), Romania ;
- Hungarian Geological Survey HGS, Office of Eastern Hungary, Hungary ;
- FETIVIZIG, Upper-Tisza Region Water Authority, Hungary ;
- HYDROKOMPLEX, VIKUV - Hydrokomplex, Privat Company, the operator of the city waterworks at Mateszalka, Hungary.
- WMAssoc, Ecsedi-Swamp Water Management Association, Association and privately owned company working in the field of water management and nature conservation in the Szamos basin, Hungary.

The general structure of the organisation of the network can be described by Figure 3.

5. Criteria of success for NATO

- 15 % Construction of a data-bases system (for storage, processing and future use);
- 20 % Creation of links between young researchers and institutions for groundwater studies and management;
- 20 % Modelling groundwater resources of the Somes/Szamos aquifer as a tool for future sustainable utilisation;

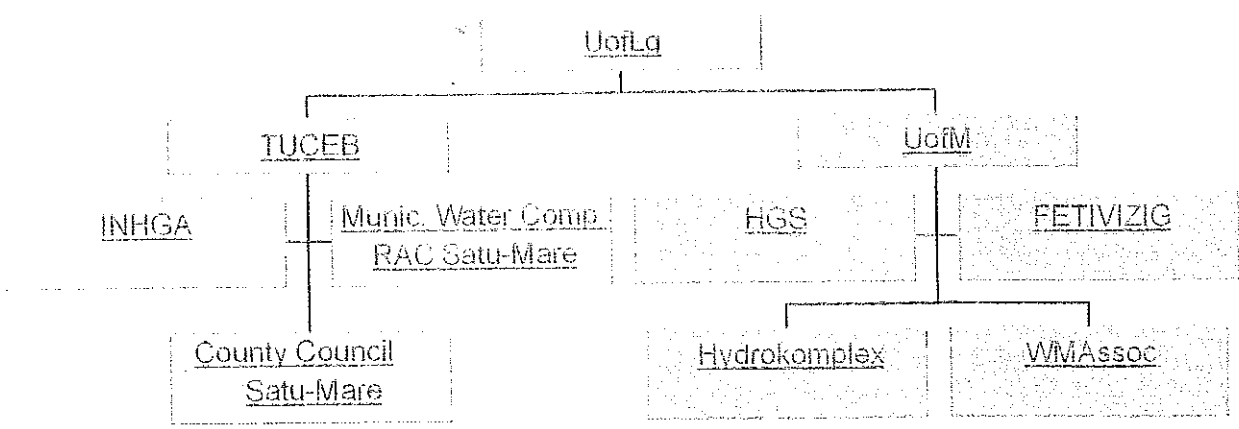

Fig. 3 General organisation of the network.

- 10 % Training of young researchers in the up to date techniques and procedures of groundwater modelling and monitoring;
- 15 % Participation of the end-users during and after the project period;
- 10 % Expansion of mandate of existing Romanian-Hungarian Committee, dealing with surface water policy, to involve groundwater issues by inclusion of policy-makers, decision-makers and related institutions;
- 10 % Two or three years after completion of the project, application of the same approach to another cross-border aquifer.