

## SOME ECOLOGICAL ASPECTS OF EFFECTIVE GROUNDWATER MANAGEMENT IN BULGARIA

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**ABSTRACT.** Groundwater – as a natural resource with both ecological and economic value are of vital importance for sustaining life, health and integrity of ecosystems. On one hand hydrogeological research cannot entirely solve anyone ecological problem in its completeness. This is the true since the object of study of the hydrogeological research is the aquifer system which is a part (an element) of the physical environment of the organisms (elements of the biological ecosystem) i.e. the behavior of just one of the factors, influencing the biological ecosystem, are analyzed without studying the reaction of this ecosystem. On the other hand an environmental impact assessment is impossible without groundwater investigations of given study area where an immediate effect exerts on physical environment. In this sense the problems connected with both assessment and forecast of groundwater balance and quality in the aquifer system have a great ecological significance and purposefulness. Hence, main objectives of groundwater managements in our country have to be achieved are:

- Effective groundwater protection within the framework of any aquifer system from the different sources of pollution;
- Sustainable use and effective exploitation of groundwater formed within the framework of the aquifer systems on the territory of the country;
- Reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order progressively to reduce groundwater pollution.

## ЕКОЛОГИЧНИ АСПЕКТИ В УПРАВЛЕНИЕТО НА ПОДЗЕМНИТЕ ВОДИ В БЪЛГАРИЯ

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**РЕЗЮМЕ.** Подземните води, като естествен ресурс притежаващ едновременно екологична и икономическа стойност, са от жизнено важно значение за поддържане на живота, здравето и цялостността на екосистемите.

От една страна, хидрогеоложките проучвания в цялост не могат да решат възникнал екологичен проблем, поради факта, че водоносните системи представляват само (части, елементи) от заобикалящата ни околна среда и тяхното поведение често се анализира без информация за обратната реакция на биологичните екосистеми. От друга страна устойчивата оценка върху околната среда в даден конкретен регион е немислима без провеждането на задълбочени и целенасочени хидрогеоложки проучвания с цел оценка и прогноза на ресурсите и качеството на водите. В този аспект, е необходимо постигането на две главни цели в управлението на подземните водни ресурси:

- Устойчива и ефективна експлоатация на наличните водни ресурси в рамките на дадената водоносна система;
- Ефикасна защита на водоносните системи от различни източници на замърсяване.

### Introduction

Groundwater – as a natural resource with both ecological and economic value – is of vital importance for sustaining life, health and the integrity of ecosystems. According to J. Turk & A. Turk "ecology is the study of the relationships among plants and animals and the interaction between living organisms and their physical environment". In this sense the problems connected with both assessment and forecast of groundwater balance and quality in the aquifer system have a great ecological significance and purposefulness. In all of the cases, however, the solution of these groundwater problems does not lead to the overall settlement of the ecological problems. This is true since an object of study of the hydrogeological research is the aquifer systems which are the part (an element) of the physical environment of the organisms (elements of the biological ecosystem) i.e. the behavior of just one of the factors, influencing the biological ecosystem, is analyzed without studying the reaction of this common ecosystem. Thus the hydrogeological research cannot entirely solve anyone ecological problem in its completeness. On the other hand an environmental impact assessment is impossible without

groundwater investigations of a given study area where an immediate effect exerts on the physical environment.

### Main objectives

The hydrogeological research will have an effective contribution when necessary and sufficient conditions will be insured an achievement of main groundwater objectives:

Effective groundwater protection within the framework of any aquifer system from the different sources of pollution;

Sustainable use and effective exploitation of groundwater formed within the framework of the aquifer systems on the territory of the country;

Reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order progressively to reduce groundwater pollution.

### Assessments

In this respect to achieve successful groundwater assessments some immediate ecological tasks should be solved:

- The determination of the special boundaries of the aquifer system:

A base of salvation of this task should be regional hydrogeological research carried out in Bulgaria. Till this moment various kind of hydrogeological maps are made. Virtually all of them, however, are in small scale. Nevertheless that these maps have made a significant contribution in the development of hydrogeology in Bulgaria at this moment they cannot be up to the current requirements of the practice for decision-making connected with groundwater protection and sustainable use. The reason for this is not exactly the small scale of the maps but rather that they are not drawn up according to the standard procedure "knowledge about local groundwater system – general conclusions". The mechanical juxtaposition of the chronostratigraphic intervals with the hydrogeological units pushed matters thus far that these hydrogeological maps cannot ensure a sufficient objective information not only for the special distribution of the particular aquifers but even for their zones of exposure on the land surface i.e. the aquifer system information in the upland areas where the run-off is formed and groundwater are of high quality, is extremely insufficient.

Since the lithostratigraphic units are "geological bodies, which differ from each other by clear distinguishing (petrological) features and stratigraphic position", favorable conditions are created for the determination of hydrogeological units on the base of lithostratigraphic principles because of the existence of direct connection between the lithological composition and/ or structure of sediments and/ or rocks and their permeability. The hydrogeologic unit segmentation should be made depending on the hydrodynamic and hydrochemical conditions of the detached hydrogeological unit. Thus, at the correct choice of the suitable morphostructural, tectonic, lithostratigraphic and geomorphological determinative indications the drawing up of qualitatively new hydrogeological map of Bulgaria would become possible by means of using reliable and current hydrogeological data. This map should solve the task for the sufficient accuracy in determination of special aquifer system boundaries.

- Determination of groundwater physical and migration parameters in a regional scale and creating of unified information data base:

The determination of the physical and migration parameters of the aquifer system should become together with the determination of its spatial boundaries. In order to estimate correctly the filtration environment - heterogeneous in the earth's crust - the whole available hydrogeological information is necessary to be collected and analyzed in appropriate manner. The aim is to get an overall picture about the filtration environment. On this base the maps of the special changes of both physical and migration parameters should be drawn up.

At present sufficient information about the parameters of the aquifer systems is available in the different firm archives but unfortunately the authorities do not express any interest in a purposeful and complete regional clarifying the properties of the particular aquifer system. Without such clarification groundwater management is impossible. That is why is extremely necessary to begin the building of a real unified automated information system for hydrogeological data (data base) which should be continuously enriched by the information received from hydrogeological investigations carried out from any licensed person or firm or authority organization.

- Determination of the balance elements of each greater aquifer systems, groundwater allocation, monitoring and control.

An appropriate policy should be adopted for preferential allocation of groundwater, giving suitable weight to competitive uses and balancing short-term demands with long-term objectives in the interest of present and future generations. In allocating groundwater resources, account should be taken of the amount of groundwater in reserve and the rate of its replenishment. Allocation of high-quality water only to uses demanding high-quality water, in particular for human and animal consumption, should be encouraged. More emphasis should be given to the nature conservation value provided by groundwater resources, in particular where nature protection areas are vulnerable to changes in groundwater conditions.

- Monitoring programmes should seek next objectives: reliable assessment of quantitative status of all groundwater bodies or group of bodies; estimation of the direction and rate of cross boundary groundwater flow; validation of impact assessment procedure; assessment of long-term trends; chemical status of all groundwater bodies or groups of bodies at risk; detection of significant and sustained upward trends in pollution concentrations; assessment of the reversal of such trends. These objectives are in accordance with next groundwater monitoring requirements: appropriate estimation of boundaries of groundwater and conceptual understanding of groundwater systems as well as groups of groundwater bodies with similar hydrogeological characteristics. Also to identify groundwater bodies at risk and assure necessarily information required to validate risk assessment. In this sense a special attention should be paid on: bad technical conditions of observation equipment; significance of interactions between both surface and groundwater and to limit indirect discharges (mining, industrial processes, manufacturing, intensive farming, including the application of fertilizers and pesticides on agricultural land, transport activities, waste disposal and treatment as well as storage of dangerous substances) introduced into groundwater bodies.

Monitoring and control should be considered public – service activity. Facilities should be set up for coordinating the assessment and availability of monitoring data information on groundwater quantity and quality characteristics of aquifers as well as details of their locations, use and exposure to various impacts from land uses such as agriculture, industry and urban development. Information should be readily available to those interested.

The data from monitoring should make it possible to revise periodically plans and forecasts of groundwater use, taking into account actual evolution of aquifers, and to determinate measures to ensure the groundwater resources sustainable use.

- Creating of conceptual physical and mathematical models for sustainable groundwater usage in the greatest high-permeable aquifer system in the country:

The hydrogeologists are facing fundamental task to ensure groundwater which should meet the requirements for quantity and quality in a given points of water-usage at any moment. Furthermore, the balance and quality composition of the aquifer system should not be considerably and irreversibly changed (i.e. sustainable groundwater use). In order to realize the implementation of this task it is necessary to form a correct physical and mathematical conception for recharge, movement and drainage of groundwater, knowledge about initial and

boundary conditions and the effects on/ in the aquifer systems. The necessary data for this should be obtained by preliminary implemented purposive investigations. Thus, the necessary conditions are created for the building of permanently active numerical models for larger permeable aquifer systems in the country. These models would ensure the possibility to receive a great number of forecasting solutions about groundwater level distribution, abstracted discharges and groundwater pollution at different moments for a very short time, in different boundary and initial conditions and effects on/ in a given aquifer system.

Groundwater models should be built so that multi-variant/ multiple forecasts can be made of the groundwater regime, particularly for aquifers at risk.

Furthermore, the unified information data base should create the conditions for onward improvement of the models.

Thus, the model research should ensure the possibility of planning and forecasting the effective protection and sustainable groundwater use.

Results of impact assessment procedures should duly be taken into account in decision making. Systematic monitoring of project realization by authorities should ensure compliance with groundwater protection.

All projects in any economic sector expected to affect aquifers adversely should be subject to an assessment procedure aiming at evaluating the project's possible impact on the water regime and/or the quality of groundwater resources, with particular attention to the important role groundwater play in the ecological systems.

Impact assessment should be undertaken at an early stage of project planning and should be systematically applied to the different alternatives in a project study

Impact assessment surveys should continue during the construction and operating phases of a project, in order to keep under review any adverse impacts on groundwater resources before, during and after human interventions.

## Strategy and planning procedures

The correct and appropriate solving of the tasks mentioned above is a good precondition for realizing of the main strategies: to prevent and control pollution of groundwater i.e. to establish groundwater chemical status and for identification of significant and sustained upward trends as well as the definition of starting points for trend reversals.

In the planning procedures, prospective studies and forecasts – both in terms of water quantity and quality – of future groundwater demands, use, consumption, discharge and environmental stress should not only be an extrapolation of past trend but should also take into account the anticipated effects of applied or foreseen control measures, economic incentives and other managerial instruments for groundwater protection. Objectives of planning, and in particular long-term planning, should not only serve the purpose of exploitation and

utilization of groundwater resources but - to an increasing extent – should serve their protection. Planning should among other elements seek to include quality – forecasts of groundwater resources for appropriate horizons, taking into account potential pollutants already in the ground and which would eventually contaminate groundwater long after strict pollution - control measures had become effective. In accordance to achieve mentioned purposes we should have into account the guidance's concerning existing groundwater directive (80/68/EEC) and the WFD, the Landfill Directive (99/31/EC), the Drinking Water Directive (80/778/EEC as amended by Directive 98/83/EC), the Nitrate Directive (91/676/EEC), the Plant Protection Products Directive (91/414/EEC), the Biocides Directive (98/8/EC) and the Commission Communication Towards Thematic Strategy for Soil Protection as well as our native regulations – published 2000 -2003 years. In addition, groundwater protection affects agricultural production. This is reflected by the cross-reference to Directive 80/68/EEC in the Commission's recent proposals on common rules relating to the review of the Common Agricultural Policy.

## Conclusions

Sustainable groundwater use is problem connected not only with concrete ecological research but exerts influence on economic, human health and other social sectors. The complex solution is possible only in case of through interactions between theory and practice. Unfortunately the lack of coordination between research institutes, universities and private firms makes impossible setting up of common national program as well as appropriate application of advanced western legislations pointed to promote a positive change in human attitude and to encourage personal involvement in the environmentally- friendly activities.

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