

Comparison of the availability of groundwater information sources in Poland with other European countries. Knowledge inventory for hydrogeology research – project KINDRA

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Abstract. Regulations of the Water Framework Directive 200/60/EC (WFD) had been applied by European Union countries into their legislation system. However, it does not guarantee that the groundwater research has the same standard and quality in EU countries. KINDRA international research project was launched to assessment of existing groundwater-related practical and scientific knowledge based on a new Hydrogeological Research Classification System (HRC-SYS). This classification is supported by a web-service – the European Inventory of Groundwater Research (EIGR). The main goal of the project is implementation policy of optimization in groundwater research in EU. The preliminary result of survey about groundwater management shows that in Poland is a good state of implementation WFD. Good level of implementation is especially related with groundwater monitoring. It is because a lot of institutions and municipal entities carry out their tasks referring to quality or quantity assessment. Results of their works are published as reports, newsletters, maps, bulletins etc. These materials are potential source of information which can be a valuable contribution to EIGR. However, a lot of information are published only in polish language, so it is impossible to spread this knowledge in Europe.

1 Introduction – about KINDRA

Water is essential „raw material”. Access to groundwater resources determines development of a settlement and cities, water is necessary for biological existence of ecosystems and efficient functioning of the environment. Nowadays water is a key-element of interdisciplinary research, especially in connections: water-food-energy-climate. That is why international projects are very important – growth of cooperation and awareness between researchers can protect in effective way this valuable „raw material”.

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KINDRA project was launched in February 2015 and is coordinating by consortium of six partners from EU. One of the objective of this project is to summarize the current state of scientific and practical knowledge in the groundwater research field in European countries. The aim will be achieved by gathering information of the results of research, projects, programs and hydrogeological databases. It will help identify the challenges and priorities for the future research [1]. The result of KINDRA project will be also Knowledge Inventory for Hydrogeology Research (EIGR) [2]. Project is coordinated by the Sapienza University of Rome, Earth Sciences Department (Italy). The main partners are: EFG – European Federation of Geologists, Redi – Environment and Water Agency of Andalusia (Spain), LPRC – La Palma Research Centre for Future Studies S.L. (Spain), UM – University of Miskolc, Faculty of Earth Science and Engineering (Hungary) and GEUS – Geological Survey of Denmark and Greenland (Denmark). European Federation of Geologists (EFG) invited to participate representatives from 20 European countries: Belgium, Croatia, Czech Republic, Denmark, Finland, Greece, Spain, Holland, Ireland, Germany, Polish, Portugal, Serbia, Slovenia, Switzerland, Ukraine, Hungary, Great Britain and Italy (Fig. 1). Countries are represented by experts - specialists in hydrogeology field. They had to select domestic sources of knowledge and information about groundwater for the EIGR database requirement.

Results of KINDRA project and the EIGR database will be analysed and used to support UE policy and implementation of water directives. Currently the most important Framework Water Directive 2000/60/EC was published 23th October 2000. WFD established a framework of action in groundwater management policy [3]. Each of EU countries were obliged to implement FWD regulations into national legislation system. Directive instructs all EU members to the rational using of water resources and protecting this resources with the principles of sustainable development. The strategic objective of EU water policy is to achieve and maintenance good quality and quantity status of the water resources which will ensure: 1) good condition of ecosystems, 2) safe access to water resources for people and environment, 3) precise definition of social and economical request of water supplies, 4) reduce the negative effects of floods and drought, 5) minimize the risk of emergency situations and 6) implementation of integrated water resources management.

Topics related with rules of rational water management and implementation of the WFD are a subject of numerous scientific works. They concern the implementation of the requirements of WFD into national legislation e. g. in the Netherlands [4] or Sweden [5]. Sometimes papers include summaries of the experiences and problems common for European countries [6]. Conclusions from these summaries allow to present guidelines and recommendations for the effective operation in water management [7]. Some of topics are linked with maintaining of good chemical status [8, 9] and good ecosystems conditions [10]. Also important is the awareness of risks and appropriate definition of challenges for the future in individual countries of Europe, e. g. Great Britain [11]. The WFD also helps to regulate activities related with specific areas of water management, e. g. in coastal areas and ecosystems of the seas [12–14] or of flood risk assessment or rivers network management [15]. The WFD regulations correspond with other branches of economy, such as agriculture, especially in context of irrigation in arid regions of southern Europe [16]. Sometimes the WFD regulations determine the subject of researches and allow to define challenges of key-topic for the future development of European economy related with climate changes [17, 18]. Growth of water deficit was the subject of discussion in Poland [19]. The deficit areas occur because of: 1) dangers for sustainable utilization of surface water and groundwater, 2) growth consumption of the groundwater resources, especially in intensively exploited areas, 3) lack of possibilities of recharge municipal water supply system. Witczak and others [20, 21] shows in their papers the role of monitoring in regard

to the presence of heavy metals in the water. Tomaszewska and Szczepanski [22] indicate the possibility of using recycled water treatment as a potential resource of drinking water.

Poland joined to the UE nations on 1st May 2004 and has its own experiences with implementation the WFD regulations into legislation system. Maciejewski and Walczykiewicz [23] showed main risks related with transfer the WFD regulations into polish law. The most important of them was lack of information or poor access to existing data, insufficient investment and risk of extending of deadlines. Participation of polish expert in KINDRA project was the opportunity to evaluate the functioning of the WFD regulations in country groundwater management.

2 Materials and Methods

KINDRA project include three stages, divided into six tasks (Fig. 2a). The first stage was to create a framework of methodology which allows to classify the projects, works and actions related to groundwater (Harmonised methodology on Groundwater Research – HRC-SYS). During this stage has been created a web-service which is the kind of metadata repository. It is the European Inventory of Groundwater Research (EIGR). In the second stage was gathered information about groundwater research and their results. All data had been input into EIGR by national experts. This step had allowed to assess and summarize scientific and practical knowledge in the hydrogeological studies in Europe. In the third stage of the project gaps in the knowledge related with groundwater will be identified. After that will be prepared recommendations for: 1) the future policy, 2) better understanding relations between surface water and groundwater and 3) acts to help prevent climate changes. The third stage was started on February 2017.

Methodology of research topics classification (HRC-SYS) had been created because there was need of using the same criteria for different kind of projects. In the first step „key words” from projects had been identified. Sources of "key words" were the most important EU regulations, documents and scientific publications related to groundwater and hydrogeology topics. Then had been identified links between subjects of research. The next step was to create ranking list based on importance of particular phrases, according to score of searching in databases like: Web of Science, Scopus and Google Scholar Web. List of about 200 key words was connected in tree hierarchy (Fig. 2b). Each of words had been linked to the three main category: SC – Societal Challenges, OA – Operational Action and RT – Research Topic. Every of this main category has been divided into five high level group (level 1). The HRC-SYS classification system was based on the assumption of interactions between the three main groups and the five high level groups.

Methodology HRC-SYS had been created for the better classification data and information in the EIGR. This database will allow to gather and management of information about groundwater in Europe. National experts had to input in the EIGR different kind of data e. g.: reports of research projects, institution reports, magazines, bulletins or technical publications linked with groundwater topics. The EIGR will be a database which complement the scientific articles and publications databases: Web of Science, Scopus, and Google Scholar.



Fig. 1. Partners in the KINDRA project (based on [2]).

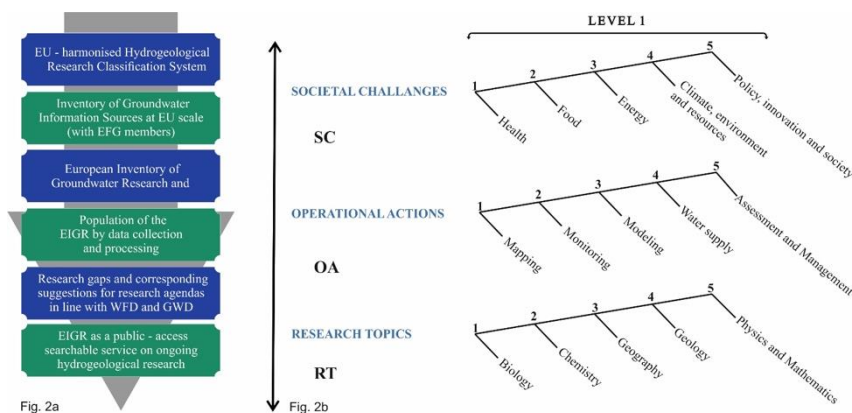


Fig. 2. a) KINDRA project stages, b) Hierarchy tree in HRC-SYS classification (based on [2]).

Stage of the data input to the EIGR has been preceded by the survey on the availability of information about groundwater in European countries [1]. Author of this survey, prof. Eva Hartai from the European Federation of Geologists, had prepared 12 questions divided into four groups (Tab. 1). The answers had been given by national experts. The survey helped them to systematize information for EIGR and make a preliminary assessment of the implementation the WFD regulations into national legislation systems.

Table 1. Groundwater data sources – questionnaire (autor: prof. Eva Hartai, European Federation of Geologists). (Answer by Polish national expert – in brackets).

Institutions dealing with groundwater research/survey	Journals/archives focused on hydrogeology
<i>– How many institutions deal with groundwater research/survey in your country? (More than 20)</i>	<i>– Are there any journals/archives focused on hydrogeology in your country? (Yes)</i>
<i>– Please fill the table for the institutions related to groundwater/survey in your country, indicating the level, the type and the data accessibility at the institution. (53 institutions, full list available in: [1])</i>	<i>– Please list the name of these journals/archives, indicating if they are on-line/printed (O/P) and English/national language (E/N). (10 issues, full list available in: [1])</i>
Groundwater withdrawal, availability of data	Groundwater monitoring, availability of data
<i>– What percentage of the drinking water derives from groundwater in your country? (More than 70%)</i>	<i>– How much of your country is covered by groundwater monitoring network/s? (Between 50-100%)</i>
<i>– Are there official data about anthropogenic groundwater withdrawals? (Yes)</i>	<i>– What type of data are collected by the groundwater monitoring network? (Quantitative and qualitative)</i>
<i>– If yes, please indicate those withdrawal types where data are accessible. (Mining)</i>	<i>– Are you aware of any parameters that are presently not monitored, but should be (in addition to those which are recommended by the European Commission)? (No)</i>
<i>– How many observation sites are in the strategic groundwater monitoring network in your country? (More than 100)</i>	<i>– Are the monitored data available on-line? (Yes)</i>

3 Results

Methodology HRC-SYS had allowed to indicate the priority category related with groundwater research. There are "Societal Challenges" and all main implementation directives and strategic EU projects which should be linked with them. HRC-SYS "Societal Challenges" include five sub-categories: 1) Health, 2) Food, 3) Energy, 4) Climate, environment and resources and 5) Policy, innovation and society. Every record which had been input to EIGR mandatory had to be classified according to Societal Challenges. For all records was also specified "Operational Action" and "Research Topic", because it helps to identify and assess in the future, trends or gaps in UE legislation and water management policy. The examples of input data and way of its classification had been shown in Tab. 2.

Table 2. An example of the classification of Polish publications according to the HRC-SYS categories.

Publication	Category HRC-SYS		
	Societal challenges	Operational actions	Research topics
<i>Atlas of the possible use of geothermal waters for combined production of electricity and heat using binary systems in Poland [24]</i>	<i>Energy</i>	<i>Mapping</i>	<i>Geology</i>
<i>Atlas of geothermal resources of Paleozoic formations in the Polish Lowlands [25]</i>	<i>Climate, Environment and Resources</i>	<i>Mapping</i>	<i>Geology</i>
<i>Groundwater monitoring in the border area of the Sudetes in 2005-2012) [26]</i>	<i>Climate, Environment and Resources</i>	<i>Monitoring</i>	<i>Geology</i>
<i>Hydrogeological annual report Polish Hydrogeological Survey (hydrogeological year 2015) [27]</i>	<i>Climate, Environment and Resources</i>	<i>Water Supply</i>	<i>Geology</i>

National experts from Poland inputs in EIGR 50 records:

- National and local reports containing facts and data – 16 inputs
- Hydrogeological maps – 6 input
- Technical reports, Guidelines, Manuals etc. – 9 inputs
- Book and book chapters – 17 inputs
- Atlases – 2 inputs.

A lot of this information is really valuable for groundwater management according to requires of KINDRA project. However, majority of them are not useful in the European scale, because the language of this issues is often only polish. The sources of this information are databases or web-services of institutions or entities whose activity and tasks are concentrated on research of groundwater or water management (Tab. 1).

The survey allowed to systematize knowledge of sources of information about groundwater and hydrogeology in Poland. There was also possibility to compare Poland with other European countries. Number of 53 institutions which operating profile is related with groundwater in Poland seems to be good achievement. It was the first place among surveying countries. Institutions listed in the survey are the entities which control the quality and condition of the surface water and groundwater. There are e.g.: National Inspector of Environmental Protection and Provincial IEP, National Sanitary and Epidemiological Agencies and Provintional SEA, Polish Geological Institute – National Research Institute with Polish Hydrogeological Survey, numerous accredited laboratories and others, including universities carrying out research work in the field of hydrology and hydrogeology.

Other successful area for Poland had been linked with questions about journals focused on hydrogeology. From all countries was 91 magazines including 10 journals from Poland. It was 11% among all of 20 countries which take part in KINDRA project. 3 of these 10 journals are published in polish language and the rest of them are published in English or polish and English. It is nearly 18% among the 40 magazines reported as available in English or English and national language in all countries.

In other areas Poland was on the standard position. It is essential for country from Europe to provide their groundwater management in way which was summarized by the Author of the survey:

- the drinking water supply is groundwater-dominated

- the strategic groundwater monitoring network are managed according to the Water Framework Directive and Groundwater Directive
- most of country are completely covered by groundwater monitoring network
- the monitored data are generally online available.

4 Conclusions

Sustainable water management is a societal challenge and is one of the priorities of European Union policy. All EU countries are obliged to implement the Water Framework Directive regulations. However nowadays there is no system which allows European countries the exchange data and information in area of implementation of EU regulations. There are only specific databases (Web of Science, Scopus, Google Scholar) with information useful for scientific workers. This situation was a reason to launch project KINDRA and repository of practical knowledge database – EIGR. Classification data and information according to HSC-SYS allows to gather data and also conduct qualitative analysis of records. Before EIGR started there was carried out a survey. The results of the survey have shown that there is a high level of implementation of the WFD regulation in EU countries, especially in the field of monitoring of the quality of groundwater.

Poland is one of the countries which implement the WFD regulations with success. There is a lot of points in monitoring network and results of research which are commonly accessible. Poland is one of the countries in which the main drinking water source are groundwater resources. It is optimistic for the future because this group of countries can propose solutions and regulations for policy related to this part of water management.

Currently in Poland there are a lot of possibilities of publishing scientific papers international spread, because of large number of journals published in English. At once there is a large number of institutions and entities which activity concern on the groundwater monitoring and water quality control. Their achievements and practical knowledge can be popularized widespread in Europe. But it is untapped potential because many of reports, bulletins, publications are available only in polish language. An opportunity to improve the situation would be widespread use of English title and abstract together with the national language.

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