

## “A project on groundwater research inventory and classification to make groundwater visible”

### INTRODUCTION

Water is a key-topic in modern society: not only is it a pivotal human, biological and environmental requirement, it also represents the engine for several research topics which are interconnected, covering the water-food-energy-climate nexus, and it has even a fundamental impact on urban systems. Groundwater is the hidden component of the water cycle, difficult to assess, evaluate and communicate. It plays a fundamental role by sustaining the health of our ecosystems, ourselves and our industrial and agricultural production. KINDRA seeks to help achieve a better understanding of the groundwater topic by providing an overall view of the scientific knowledge that exists across Europe.

### AIM OF THE PROJECT

Practical and scientific knowledge related to groundwater research and innovation is scattered amongst various actors throughout Europe. **KINDRA will develop an inventory of this groundwater knowledge-base, following a newly developed EU Harmonised Research Classification System (HRC-SYS)** (Fig.1). This requires an effective assessment of the state-of-the-art of hydrogeology research across different geographical and geo-environmental settings, allowing for direct comparison and identifying synergies in groundwater research.

**A European Inventory of Groundwater Research results (EIGR) will be compiled, including survey results and research activities, projects and programmes, all of which are essential to identify and determine future trends, critical challenges and research gaps** (Fig.1).

The objective is to improve management and policy development for groundwater resources on a EU level coherently with the Water Framework Directive<sup>1</sup> (WFD) and the Groundwater Directive<sup>2</sup> (GWD). Following this classification, the inventory will provide a **public-access service for European hydrogeological research in progress** (Fig.1).

- Create a uniform EU-harmonised categorisation approach / terminology for reporting groundwater research (a Hydrogeological Research Classification System – HRC-SYS)
- Carry out EU-wide assessment of existing practical and scientific knowledge (using the developed HRC-SYS) focusing on EU, national, regional, international and EU-third party scientific activities
- Create a European Inventory of Groundwater Research and Innovation (EIGR). This register will be supported by a web-service that will be searchable by selected key-words and will support users with query functions for statistics, diagrams, and others concise data elaboration
- Use the data in the register and the developed analytical tools (qualitative/quantitative) to assess the performance of key ongoing EU, national, regional, international and EU-third party hydrogeological scientific and innovation activities and results
- Compare the results with existing recommendations and position papers, outcomes of past Projects workshops, recommendations by the EIP on Water /WssTP
- Define research gaps and corresponding suggestions for research agendas in line with WFD<sup>1</sup>
- Deploy the Register as a public-access service, to be used as a permanent, searchable service on ongoing hydrogeological research and innovation

### PROJECT CONSORTIUM:

Project coordinator: “La Sapienza” University of Rome, Earth Sciences Dept., ITALY  
EFG- European Federation of Geologists, BELGIUM  
UM- University of Miskolc, Faculty of Earth Science and Eng., HUNGARY  
REDIAM- Environment and Water Agency of Andalusia, SPAIN  
LPRC- La Palma Research Centre for Future Studies S.L., SPAIN  
GEUS- Geological Survey of Denmark and Greenland, DENMARK

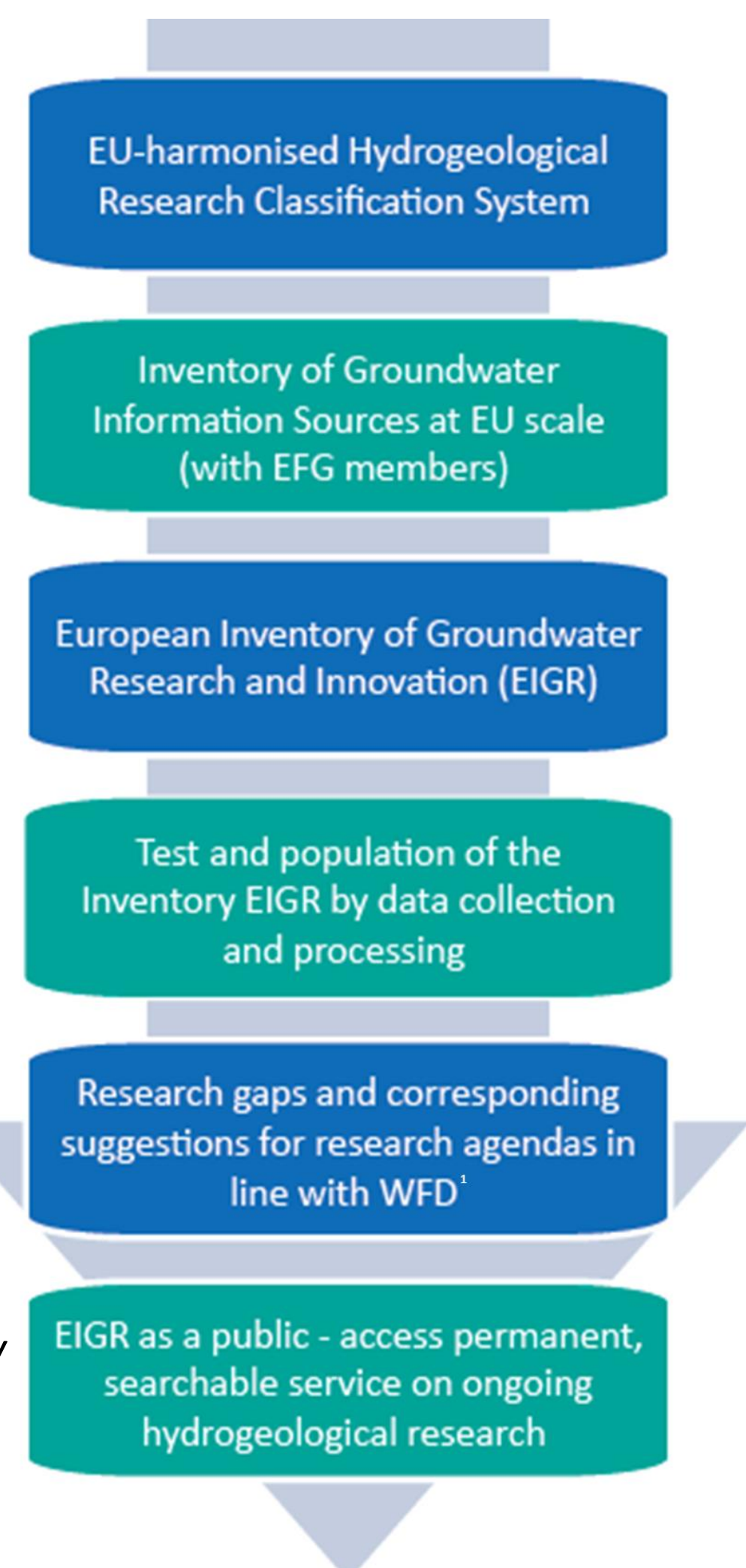
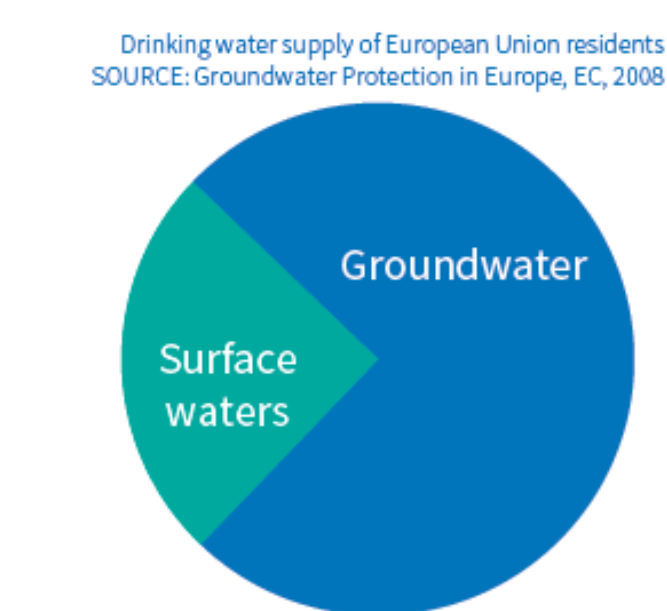


Figure 1 KINDRA project approach.

### PROJECT OVERVIEW

**Raising awareness on the importance of groundwater is our priority. KINDRA will work together/or in close collaboration with the technical and scientific community, stakeholder groups and with the general public.**



KINDRA counts on the direct involvement of the **European Federation of Geologists (EFG)**, which will provide the technical expertise of its national members actively cooperating within the project (Fig.2).

The project will also benefit from the support of **a Joint Panel of Experts (JPE)**, will be in close interaction with different EU Groundwater Associations, Networks and Working Groups (Fig.2). This will facilitate community involvement and dissemination.

All technical content and results will be finally adapted into outreach materials that will help the general public to understand the **relevance of groundwater in daily life**.

### Who helps us?

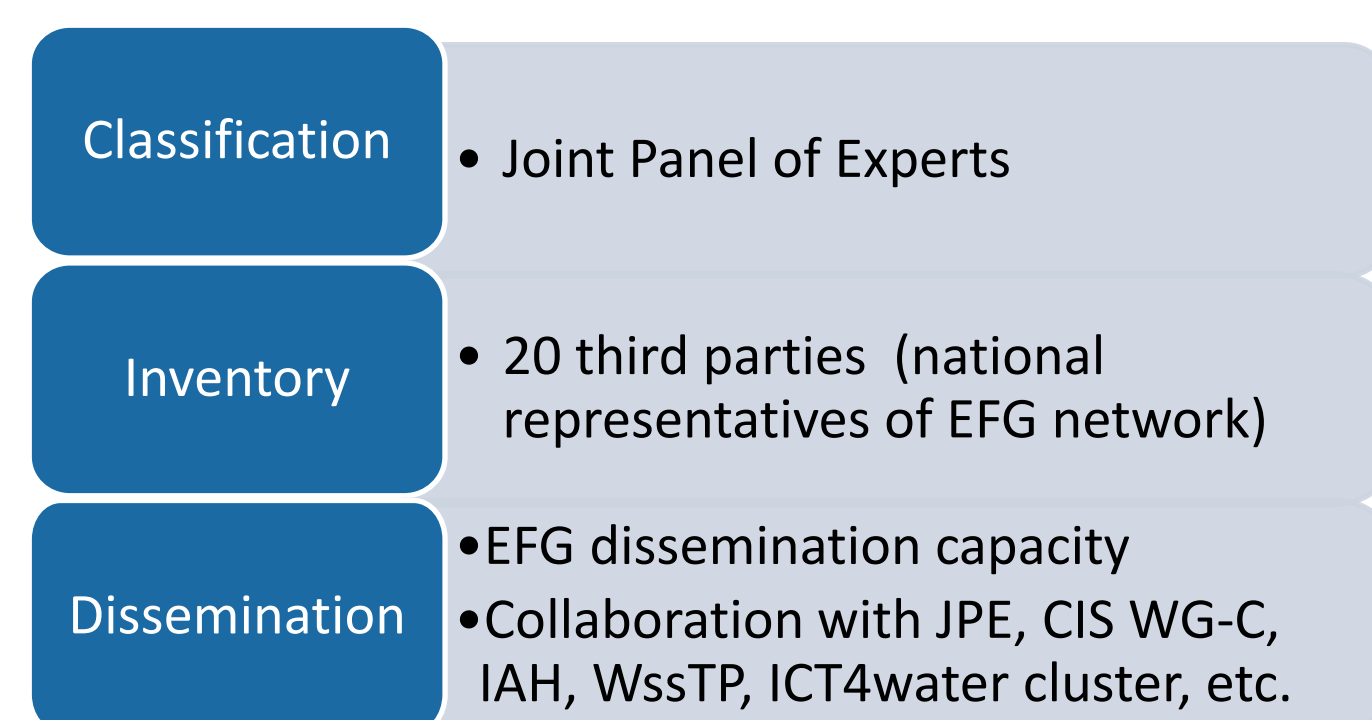


Figure 2 External communities involved in KINDRA project. (CIS WG-C: Common Implementation Strategy, Working group C; IAH: International Association of Hydrogeologists; WssTP: Water supply and sanitation Technology Platform; ICT4water cluster: Information and Communication Technologies for Water Cluster)

The project started on January 1<sup>st</sup> 2015 and lasts for 36 months; work is organized into five work packages (Fig. 3)

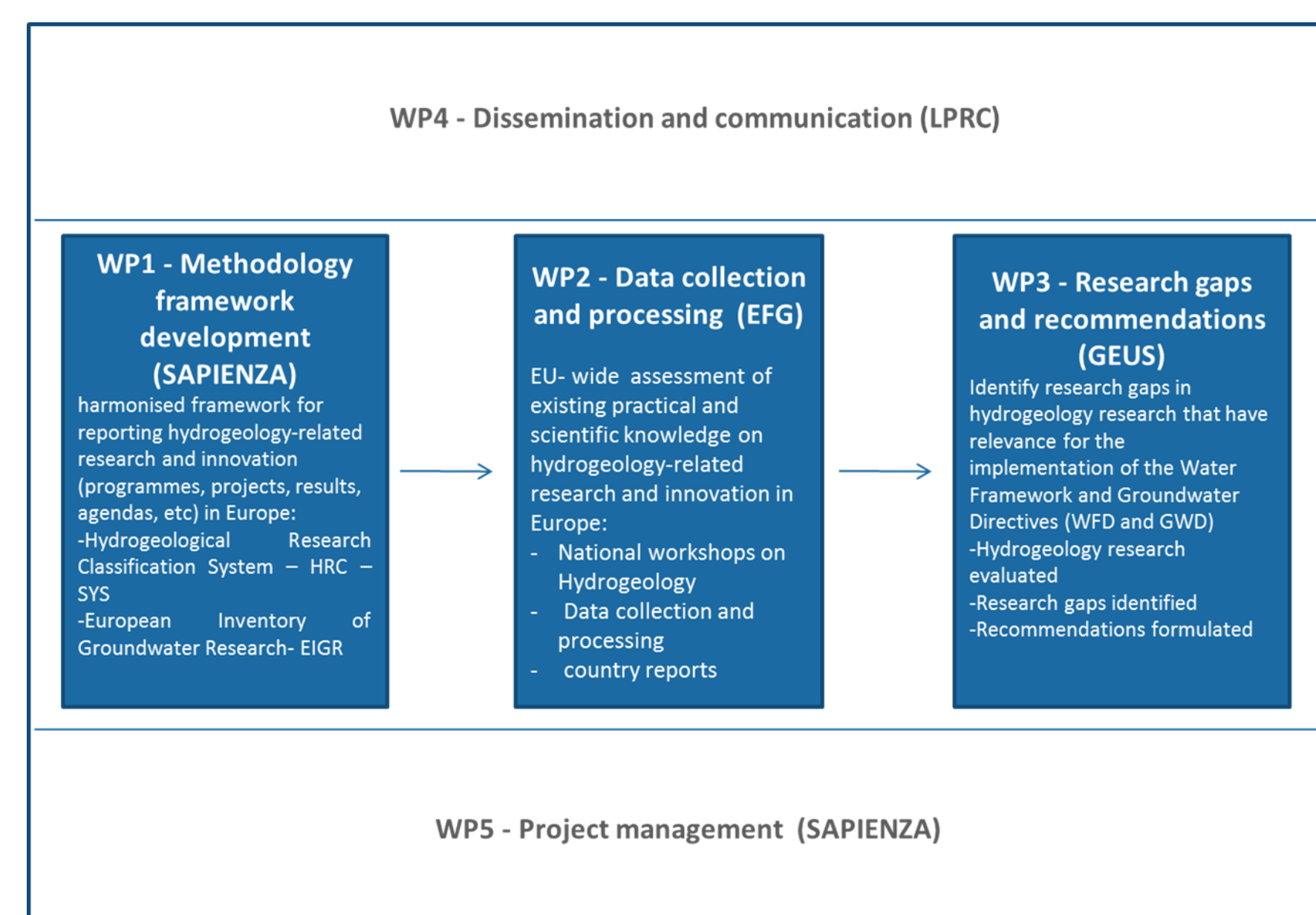


Figure 3 KINDRA workflow.

### END USER SURVEY

This activity (D4.7 of the project) aimed to assess the needs and requirements of future project end-users. Task was carried out via an online survey in the Spring 2015, and work also included the identification of potential project stakeholders and the improvement of a corresponding contact database that will be used as a base for project dissemination and communication activities in the coming years. The survey was conducted by a Google Survey tool and included five sets of questions each focusing on different aspects of the project. The evaluation is based on 161 responses originating from 132 different organisations from 22 countries. Result confirmed end-users' interest in the activities that had been previewed by KINDRA and provided very useful information for the successful development of the technical WPs (WP1, WP2 and WP3).

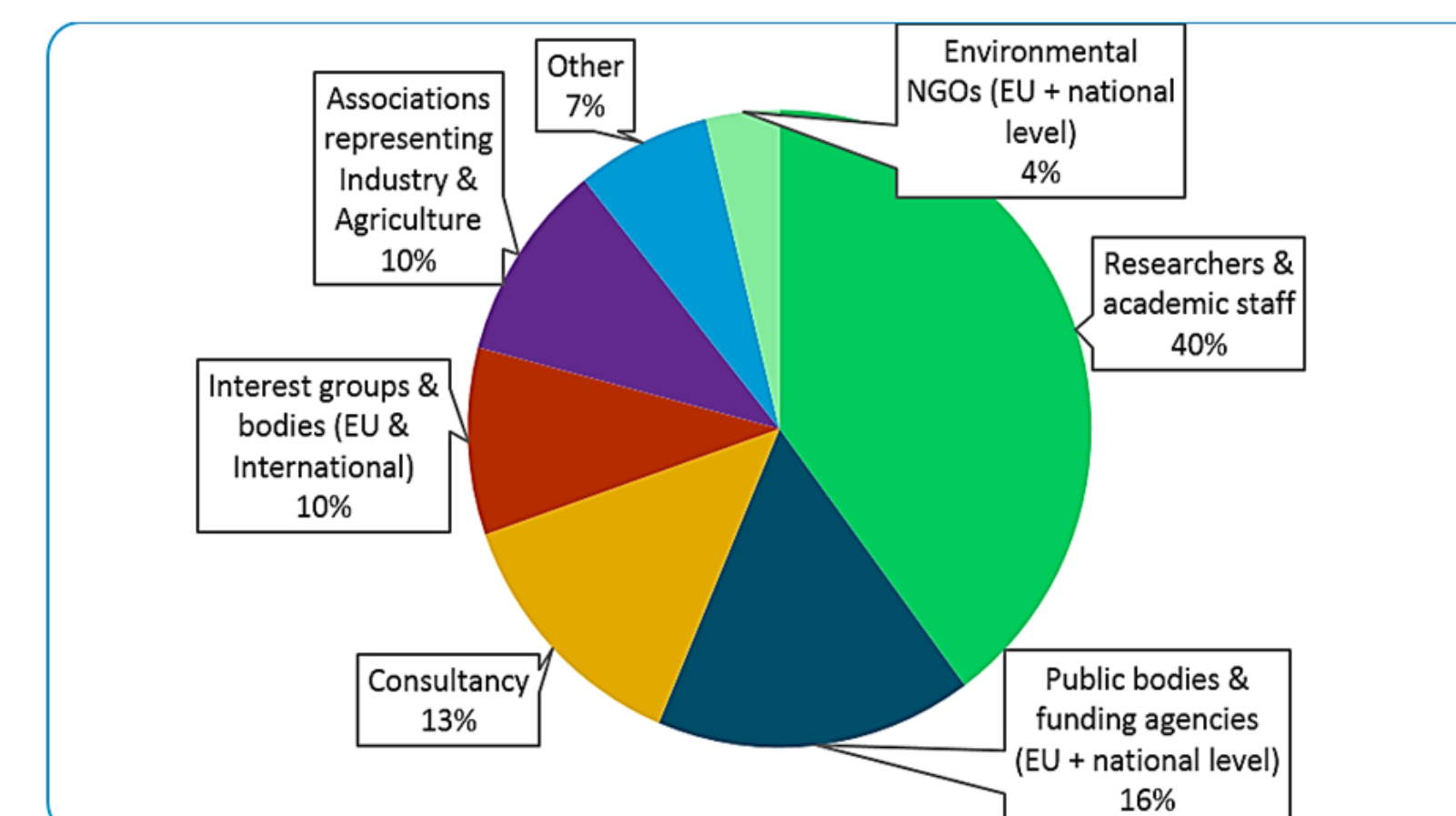


Figure 7 Background of survey participants (100% = 161 responses).

### SCIENTIFIC APPROACH & PRIMARY RESULTS

- 1 For developing the common terminology on which to base the EIGR through the HRC-SYS, keywords characterizing research on groundwater have been identified following two approaches: (1) from the most important **EU directives and documents**, i.e. the **WFD<sup>1</sup>**, **GWD<sup>2</sup>** and **The Blueprint to Safeguard Europe's Water Resources<sup>3</sup>**, and (2) from **groundwater related scientific literature**, which has been fundamental for identifying relationships and intersections between topics, themes and activities. To assess the importance and pertinence of the keywords, these have been ranked by performing searches via the Web of Science, Scopus and Google Scholar search engines.

- 2 The complete merged list of keywords consisting of about 200 terms has been organized in a **tree hierarchy**, identifying **three main categories**: Societal Challenges (SC), Operational Actions (OA) and Research Topics (RT) (Fig.4). In each of these three categories, **5 overarching groups** have been defined for easy overview of main research areas, representing level 1 (Fig. 4). All identified keywords have been categorized into one of these overarching group in up to three levels ( levels 2, 3 and 4) where appropriate (Fig.5).

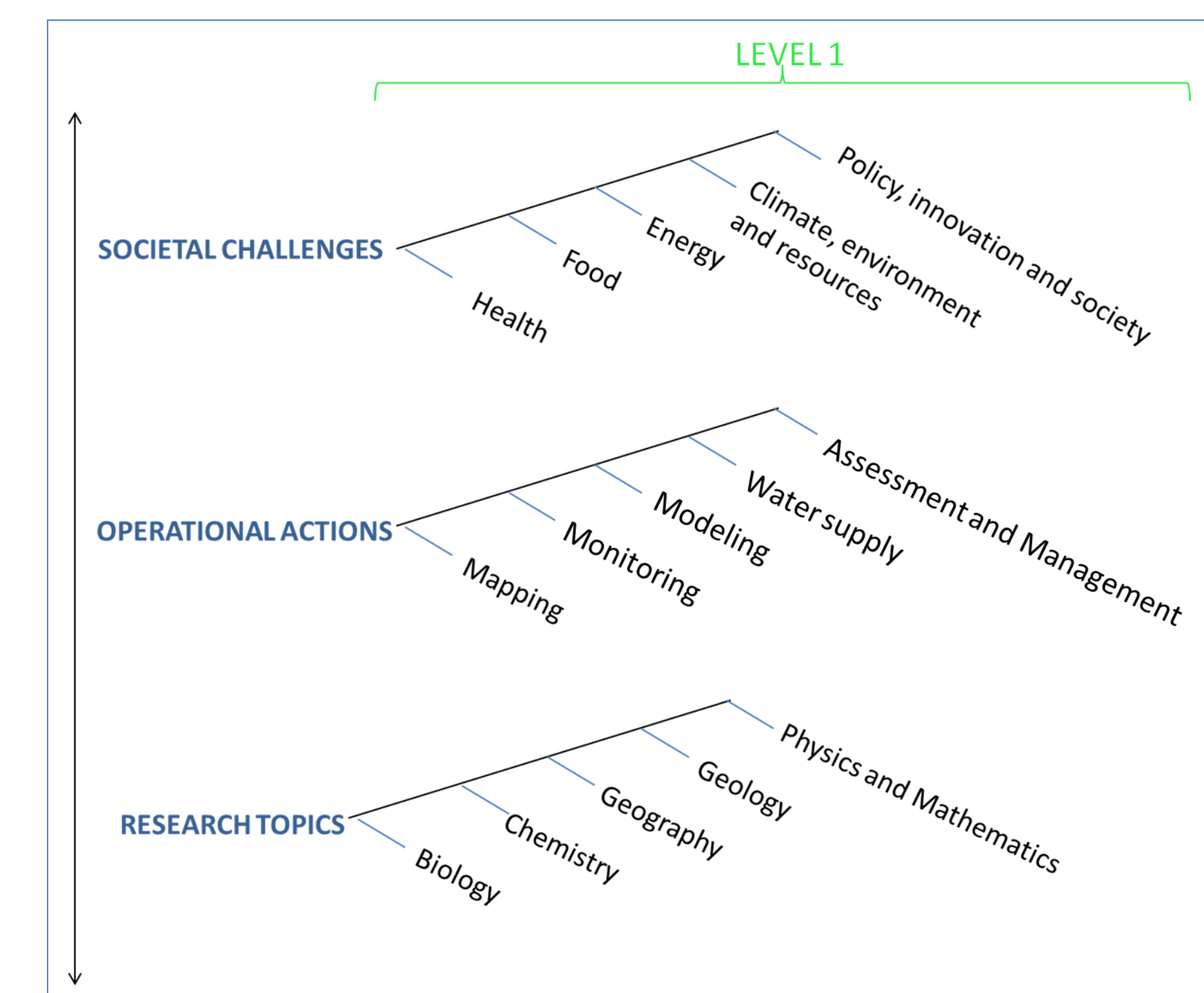


Figure 4 Main categories organized in a tree hierarchy diagram.

- 3 The classification system previews the interaction among the three main categories through a **3D approach** (Fig.5), where along each axis the 5 overarching groups are indicated. This also results in a **2D representation** for each of the Societal Challenges, where Operational Actions and Research Topics intersect in a 5x5 matrix (Fig.6).

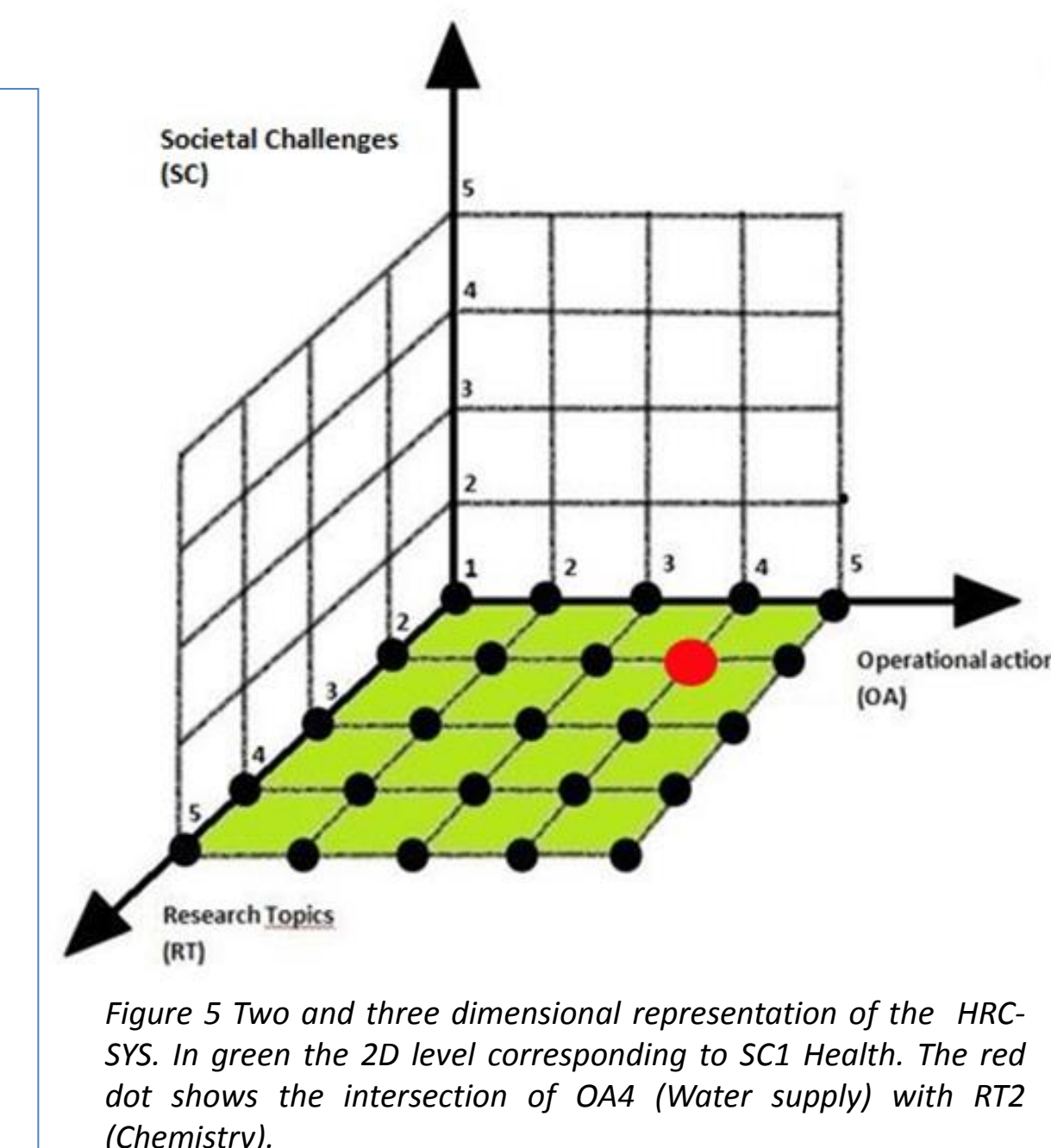


Figure 5 Two and three dimensional representation of the HRC-SYS. In green the 2D level corresponding to SC1 Health. The red dot shows the intersection of OA4 (Water supply) with RT2 (Chemistry).

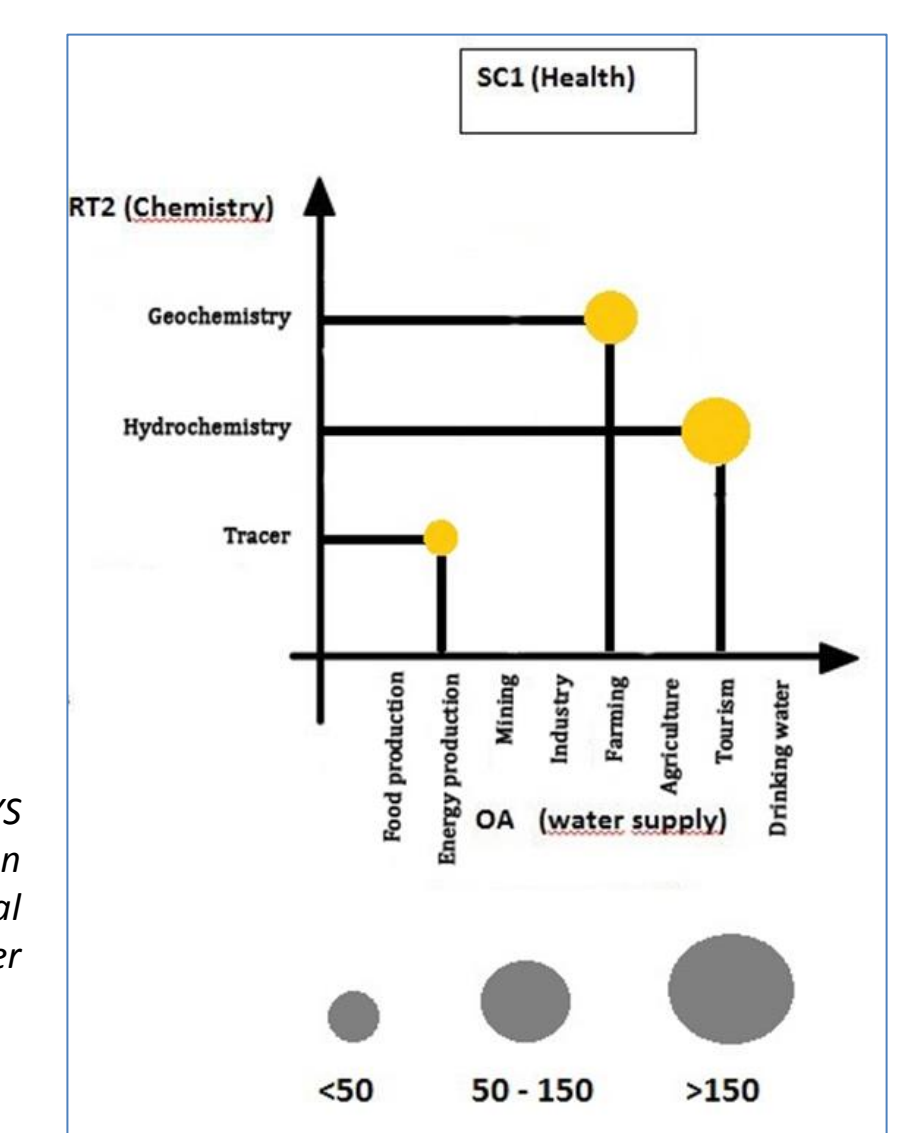


Figure 6 Two dimensional representation of the HRC-SYS for SC1-Health: example related to the intersection between Research Topic 2 (Chemistry) with Operational Actions 4 (Water Supply). Circle size represents number of publications for each of the third-level intersections.

### REFERENCES

- 1- European Commission, 2000. Directive 2000/60/EC (Water Framework Directive) of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. OJ L 327, 22.12.2000, pp 1- 51.
- 2- European Commission, 2006. Directive 2006/118/EC (Groundwater Directive) of the European Parliament and of the Council, Official Journal of the European Union L 372/19.
- 3- European Commission, 2012. Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions – A Blueprint to Safeguard Europe's Water Resources, COM(2012) 673, SWD (2012) 381-382.

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Figure 8 Partnership.