# KINDRA PROJECT

Groundwater as cross-cutting issue for tackling Societal Challenges in Europe



### **KEY POLICY MESSAGES:**

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Groundwater research is conducted within Societal Challenges of Horizon 2020, and related identified gaps need to be addressed by the scientific and technical community to ensure the development of correct and useful policies.

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Groundwater research is significantly increasing in Europe reflecting growing attention to and importance of groundwater issues as a consequence of the adoption of the Groundwater Directive.

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Transfer and translation of research results in powerful policy solutions require a catalizer, able to catch research tendencies and to identify the societal needs, here represented by the technical Working Group on Groundwater for the Common Implementation Strategy of Water Directives

### **ABOUT H2020 PROJECT KINDRA**

The mission of KINDRA is to make groundwater visible by demonstrating its interdisciplinarity and importance to all the grand societal challenges of Horizon 2020 and EU water policies. The project provides a new classification system for groundwater research and knowledge, which includes the reference to the European Societal Challenges, and makes it available in the European Inventory of Groundwater Research (EIGR).

The EIGR inventory, currently containing more than 2200 records, provides a critical mass for scientific exchange of information and it is a single access point to the knowledge-base including grey literature, i.e., non-peer-reviewed documents supplementing professional research databases of peer-reviewed scientific publications. The analysis of the content of this inventory and other research databases is useful to identify existing and missing research and knowledge supporting the implementation of the Water Framework and Groundwater Directives.

This policy brief is part of a series of two whose goal is to illustrate the KINDRA approach, achievements and future potential.



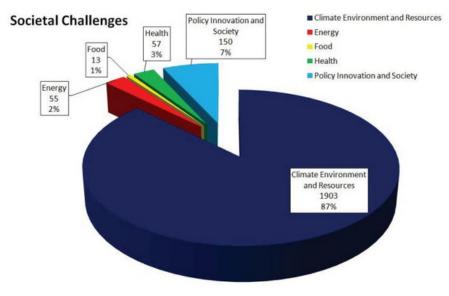
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## GROUNDWATER & SOCIETAL CHALLENGES: NEXUS AND GAPS (1)

Groundwater has been demonstrated to have links with all seven Grand Societal Challenges identified by H2020, but specifically for some of the Societal Challenges, groundwater research and knowledge has been found to be particularly relevant, leading to the following recommendations:

Societal Challenge 1 'Human health, demographic change and well-being': (a) an increasing amount of new emerging contaminants in groundwater and the rest of the hydrological cycle corresponds to a rapid increase in related research outputs; (b) studies on health effects and natural backgrounds of arsenic and nitrate and derivation of groundwater threshold values are highly warranted; c) groundwater studies are needed on pharmaceuticals, hormones, degradation products of micro-organics and related cocktail effects, nanoparticles and microplastics in groundwater and chemical status of groundwater in relation to human health and the ecological status of ecosystems.

Societal Challenge 2 'Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy': (a) the relatively low number of publications indicates a research gap on the topic of finding efficient tools for reducing nitrogen loadings to ecosystems via groundwater; (b) knowledge gaps exist on linking ecosystem status to poor groundwater chemical status and groundwater threshold values e.g. for protection of ecosystems based on good status objectives of the WFD and GWD. The latter requires better possibilities for transdisciplinary research between hydrogeology and ecology.



Societal Challenge 3 'Secure, clean and efficient energy': Research activity has shifted towards renewable energy resources, requiring securing clean and efficient energy: a) assessing water resources needs for geothermal energy and other deep and shallow groundwater and energy exploitation-related activities; b) developing improved methods for protecting groundwater resources in areas with competing interests of geo-energy exploitation and waste disposal, reducing related pollution risks; c) establishing monitoring programmes for derivation of natural backgrounds and groundwater threshold values, for assessment of groundwater chemical status in areas with geo-energy exploitation, CO2 storage and nuclear waste disposals, etc.

Societal Challenge 4 'Smart, green and integrated transport' Groundwater research in relation to SC4 is not as abundant as for the other SCs. Stimulating research in the following groundwater related topics is recommended: Climate proofing of roads, railways, airports and the built environment in general, e.g., in relation to groundwater flooding, mitigation of cloudburst events and nature-based solutions; Geohazards, e.g., related to landslides, land subsidence, flooding and urban development; De-icing of roads and airports; Fuel storage and pollutant transport.

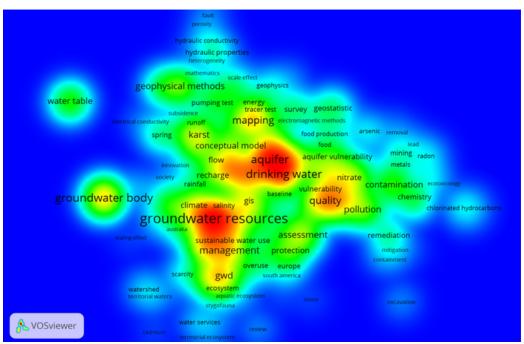
# GROUNDWATER & SOCIETAL CHALLENGES: NEXUS AND GAPS (2)

Societal Challenge 5 'Climate action, environment, resource efficiency and raw materials': This SC hosts the highest scholarly output of all considered societal challenges, demonstrating there is a general adequate development in groundwater research; climate change (impact, mitigation and adaptation), urban hydrology and the significance of both deep and shallow groundwater, e.g. in connection to nature-based and subsurface water solutions and green infrastructure is underrepresented and constitutes a gap in research to be quickly addressed.

### Societal Challenge 6 'Europe in a changing world - inclusive, innovative and reflective societies':

Groundwater research and knowledge may have the least relevance for this SC and it was not specifically evaluated in the KINDRA project. However, some possible development and interaction can be related to: a) easy access to sustainable use of freshwater resources for the developments of innovative and reflective societies; b) resilient societies in a changing world with projected significant global and climate change; c) public participation in scientific research, participatory monitoring of groundwater relevant variables such as water table and river discharge as part of citizen science.

Societal Challenge 7: 'Secure societies - protecting freedom and security of Europe and its citizens' Research areas in this SC cluster embraces a large variety of subsurface uses and interrelated environmental, policy and societal issues, leading to the following recommendations: a) increase research on risks related to the use of groundwater resources potentially causing severe water table decline and land subsidence:



Density map of keywords used in the entire EIGR

b) research areas around topics including aquifer, groundwater pollution, groundwater resources, environmental impact and monitoring need to be sustained and strengthened; c) multidisciplinarity and broadly supported integrated approaches in groundwater research must be embraced with strong links between environmental, policy and societal issues; d) continuous assessments of interactions within the Water-Food-Energy NEXUS and risks of related subsurface activities, such as nuclear waste disposal, CO2 storage and shale gas exploitation; e) conflicting or competing interests in the use of the subsurface, including groundwater resources, raw materials, geoenergy and space (e.g., in urban, built environments').

# FURTHER ACTIONS FOR TACKLING THE SOCIETAL CHALLENGES \*\*quatic \*coopystem\*\* protection\*\* \*water services\*\*

- Develop new mission-oriented research programmes and define targets for groundwater indicators;
- Expand resources on groundwater research and knowledge and make them more visible for citizens and politicians;
- Groundwater management and protection must be based on sustainable and geoethical principles ensuring a good quantitative and chemical status of all groundwater bodies to the benefit of all EU citizens and ecosystems;
- EU needs to continuously strive towards sustainable and integrated management of the subsurface resources as well as groundwater and surface water through the continuous support of innovative nature-based and subsurface water solutions;
- Develop new efficient tools for environmental monitoring and data management and visualization e.g. via efficient IoT solutions, to be considered also as an important market for European companies and consultants;
- Strongly support tools for improved integrated groundwater and surface water management and climate change impact assessment and adaptation;
- Conditions for competitive water-related industry including groundwater and water patents in general need to be continuously adapted, optimised and further developed;
- Promote and grant new innovative techniques related to new digital developments such as 'cloud computing', Information and communication technologies (ICT), internet of things (IoT) and 'big data';
- Pursue more research on conditions for innovation and patent applications for groundwater relevant or related technologies in Europe.

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EFG - European Federation of Geologists, BELGIUM

EFG 20 National Associations

REDIAM - Environment and Water Agency of Andalusia, SPAIN

LPRC - La Palma Reseach Centre for Future Studies S.L., SPAIN

UM - University of Miskolc, Faculty of Earth Science and Engineering, HUNGARY

 ${\tt GEUS-Geological\,Survey\,of\,Denmark\,and\,Greenland,\,DENMARK}$ 

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