

# KINDRA PROJECT

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

### KEY POLICY MESSAGES:

#### I

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.

#### II

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.

#### III

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.



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

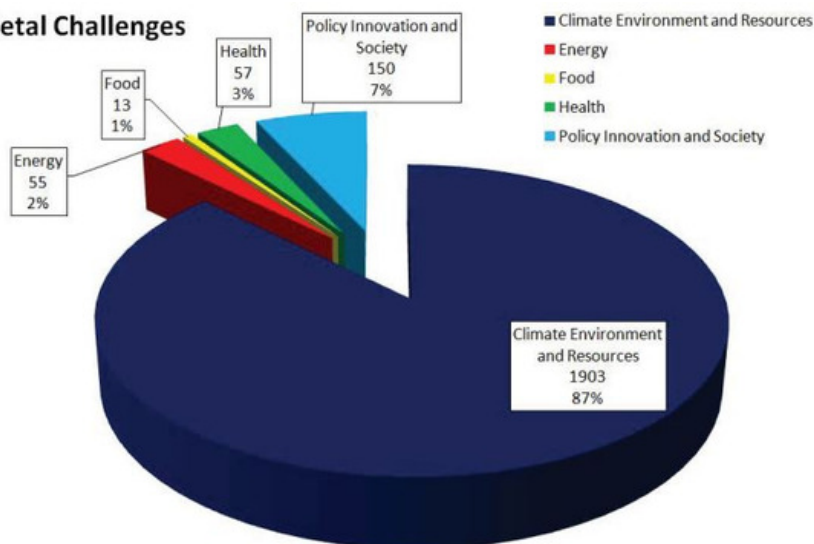
Groundwater has been demonstrated to have links with all seven Grand Societal Challenges identified by H2020, but specifically for some of the Societal Challenges, groundwater research and knowledge has been found to be particularly relevant, leading to the following recommendations:

**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 Challenges**



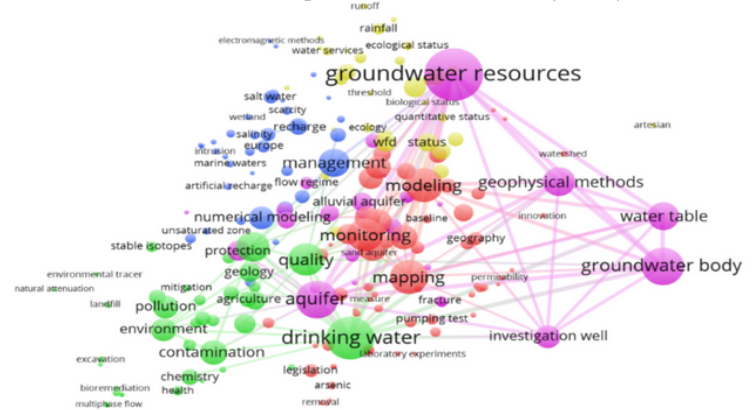
**Societal Challenge 4 'Smart, green and integrated transport'** Groundwater research in relation to SC4 is not as abundant as for the other SCs. Stimulating research in the following groundwater related topics is recommended: Climate proofing of roads, railways, airports and the built environment in 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.





The word cloud visualization displays research trends in groundwater resources from 1980 to 2017. The words are arranged in a network where size indicates frequency and color indicates time period. Central nodes include "groundwater resources", "aquifer", "monitoring", "mapping", "quality", "management", "water supply", "recharge", "flow", "geochemistry", "stable isotopes", "contamination", "heavy metals", "mining", "health", "pharmaceutical", "sulphate", "multi-screen wells", "food production", "food", "slug test", "geostatistic", "emerging contaminants", "aquifer vulnerability", "fracture", "porosity", "fault", "rainfall", "GIS", "dating", "fracture", "stable isotopes", "pore flow", "aquitard", "land use", "status", "indicator", "cadmium", "north america", "quantity", "coupled groundwater surface water modeling", "groundwater body", "transboundary", "sand aquifer", "artificial recharge", "storage", "artesian", "policy", "integrated management", "legislation", "ecosystem", "protection", "terrestrial ecosystem", "aquatic ecosystem", "water services".

- EIGR network maps of scientific papers (above)  
and non peer-reviewed records (below)



The KINDRA Partnership:  
Project Coordinator: Sapienza University of Rome, Earth Sciences Department  
ITALY  
EFG - European Federation of Geologists, BELGIUM  
EFG 20 National Associations  
REDIAM - 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  
GEUS - Geological Survey of Denmark and Greenland, DENMARK

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