RI/05

GROWADRISK

Drought-related vulnerability and risk assessment of groundwater resources in Belgium

DURATION OF THE PROJECT
01/06/2012 – 30/05/2016

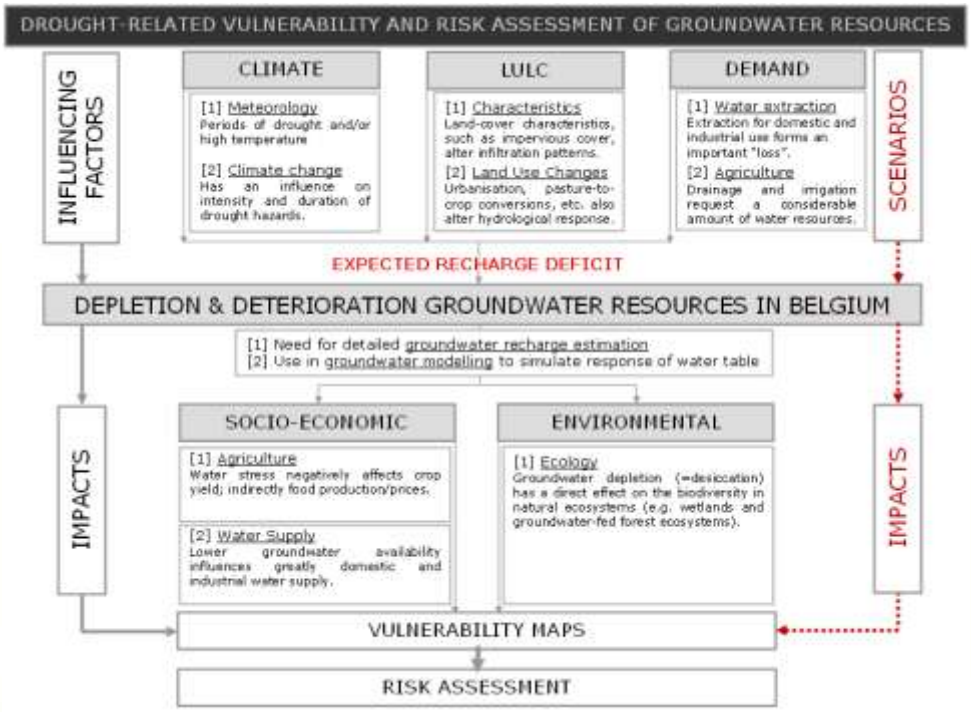
BUDGET
1.000.000€

KEYWORDS
groundwater drought, temperate conditions, influencing factors, impacts, vulnerability

CONTEXT

Due to the assumed insignificance of drought hazards under temperate conditions this field remains poorly studied. In the first place drought is a phenomenon caused by deficient precipitation for a large area and significant duration. In case the temporary water deficiency affects groundwater bodies, the term groundwater drought is used. Groundwater droughts develop slowly but can have considerable socio-economic and environmental consequences. Next to natural meteorological variations also human induced factors play a role. There is a need for an improved understanding of groundwater drought and the human-induced factors influencing the groundwater balance. This should form the basis for an integrated approach which allows tackling negative effects and safeguarding sustainability of groundwater resources.

PROJECT DESCRIPTION



The figure below summarizes the problem of depletion and deterioration of groundwater in the Belgian, temperate context and the related socio-economic and environmental impacts.

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Objective

This study aims at overcoming the lack of research with respect to (groundwater) drought hazards under temperate conditions by:

- Increasing policy-relevant understanding of influencing factors (climate-land use/land cover-demand) determining groundwater drought in a temperate context.
- Obtaining reliable spatially distributed timeseries for groundwater recharge and water table levels, enabling to describe where (space) and when (time) groundwater drought occurred/occurs.
- Assessing the socio-economic and environmental impacts of groundwater drought at a large catchment scale for the present and future situation (coming 30 years).
- Mapping the individual and combined vulnerability of groundwater resources.
- Assessing the risk as a monetary loss in order to enable objective evaluation and reduce the groundwater drought risk towards the future.
- Developing a methodology and supporting quantitative tools aimed at planning and decision support with respect to groundwater management, applicable at the level of river basins in Belgium and beyond.
- Informing the public, consisting of domain specialists and lay persons, about the results of the analysis carried out in the case region, by means of an Internet-based indicator atlas.

Methodology

A combined water balance and groundwater modelling strategy is applied to obtain a reliable spatially distributed recharge and water table timeseries. The study area is the Dijle and Demer catchment in central Belgium, which corresponds more or less with the underlying vulnerable Brulandtkrijt groundwater system.

The first step is a groundwater drought hazard assessment to increase knowledge and understanding of groundwater drought in a Belgian context. Starting point is a thorough analysis of the main influencing factors. Regarding the climate factor, a hydro-meteorological time-series analysis combined with a drought index approach enables the identification and characterization of historical and recent drought hazards. Land-use/land-cover characterization focuses on the estimation and mapping of agricultural land use change and change of impervious fraction cover, which are very sensitive and determining parameters for recharge estimation.

Once the spatially distributed recharge and water table timeseries is obtained the baseline scenario, which represents a sustainable groundwater system, is defined. Based on groundwater simulations the baseline (reference) and current status of agriculture (crop yield), natural ecosystems and water supply are determined. A next step is to study the impact of changing influencing factors on the total system. Readily available socio-economic and climate scenarios (SRES from IPCC) for the future are combined with specific demand scenarios and used in a land-use change model. Using the water balance and groundwater model the individual and overall impact can be assessed, not only on groundwater resources, but also on future agricultural production and natural ecosystem health. This impact analysis forms the basis for vulnerability mapping for each of the separate aspects.

Finally the baseline scenario (sustainable system) and the defined threshold functions (“rules”) are used in combination with the scenario simulations to determine the separate risk for relevant socio-economic activities (agriculture, industry, etc.).

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INTERACTION BETWEEN THE DIFFERENT PARTNERS

This research project has a strong focus on interdisciplinarity. An important part of the proposed network's strength lies in the complementary expertise of each of its members in different domains, including: hydrological modeling (VUB-H), agro-meteorology and crop yield modeling (ULg), LULC mapping and characterization (VUB-G), land-use dynamics modeling (VITO), modeling vegetation dynamics (INBO) and drought characterisation and drought risk assessment (NTUA)..

EXPECTED RESULTS

The outcomes of the project (see objectives) will serve concerned authorities and those responsible for operational management in setting priorities for an integrated sustainable management and a reduced risk for groundwater resources in Belgium. Moreover such an approach is essential in meeting the requirements of the EU Water Framework Directive (WFD) towards EU member states to describe and monitor their groundwater resources.

PARTNERS

The scientific activities within the frame of the GroWaDRISK project can be divided into seven main research topics:

INFLUENCING FACTORS
- a. Rainfall analysis and drought hazards assessment (Partner 2 & Partner 6)
- b. Impervious surface mapping (Partner 3)
- c. Land-use change scenario modelling (Partner 4)

GW SIM
- d. Water budget and groundwater table simulation (Partner 1)

IMPACT
- e. Impact assessment on agriculture (Partner 2)
- f. Impact assessment on natural ecosystems (Partner 5)

RISK
- g. Drought risk assessment (Partner 6)

A strong interaction between the different teams is essential for the development of an integrated methodology, which will facilitate sustainable management of groundwater resources with direct use for decision makers and end-users.

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