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Knowledge gathering about local freshwater buffering in a salty subsurface

Opportunities and challenges of the technical, geo-hydrological, socio-economic and policy aspects

Summary

Introduction

Due to climate and socio-economic changes, the pressure on fresh water supply increases in the (near) future. Climatic predictions assume greater irregularities. The risk of drought, but also of flooding, is increasing in the Netherlands. In addition, salty seepage pressure goes up due to sea level rise and land subsidence.

The current top-down approach, in which the government provides fresh water, is becoming inadequate. Small-scale (local) solutions can provide answers. Local initiatives and the regional/nationwide water systems should integrate a sustainable whole. A highly potential method to increase self-reliance is local underground freshwater storage.

At this moment several pilot studies for different methods of underground freshwater storage are carried out in the western part of the Netherlands. These provide more clarity about the limitations and challenges of the technical, geo-hydrological, socio-economic and policy aspects that needs to be taken into account. In this knowledge gathering are three specific pilot studies considered: 'ASR coastal', 'the Freshmaker' and the 'Creek Ridge Infiltration Test'.

By means of interviews, desk study and field visits, the playing field of fresh water storage in salty sub surfaces is mapped out and brought together in a readable knowledge gathering. The considered pilots have in common that fresh water is brought into a brackish or salty subsurface by gravity during wet periods, only to be actively withdrawn by means of a pump when the water is needed. This form of storage /buffering is internationally known as aquifer storage and recovery (ASR). The focus pilots are small-scale, shallow (up to 40 meters below the surface) and for horticulture, fruit cultivation and/or agriculture. More information about the pilots can be found on the websites listed at the end of this summary.

Findings and results of the pilot studies are insufficiently brought together and shared with a broader audience. Here lays a task for the Waterbuffer Foundation; to bring knowledge together in an applicable way so that overview can be obtained about what is currently happening in the field of these ASR methods and to increase application possibilities. Insights from experiences in the Netherlands can be used in other areas/deltas in the world to increase fresh water availability during dry periods.

Conclusions

The possibilities that the salty subsurface provides as medium to store suitable freshwater, come increasingly into focus, and are going to be used more in the near future.

Small scale ASR in a salty environment is in a very interesting stage, were up scaling from pilot studies to a broader application beckons. An overview of the entire playing field of opportunities and challenges is summarized in table 1.

Table 1. Summarized aspects

	Opportunities	Challenges
Technical	Increased reliability	Optimizing recovery rate
	Increased self-reliance	Well obstruction
	Space saving on the surface	Usability and robustness of the system
	(International) experience	Self-learning ability of installation
	User friendly	Extrapolation of pilot study results
	Recovery efficiency	
Geo-hydrological	Salty subsurface as a medium to store fresh water	Reactions with soil (water)
	Modelling detail and performance	Bubble management
	Quality of reclaimed water	Irreversibility of soil pollution
		Anthropogenic influences and interference
		Bubble size
Socio-economic	Cost competitive with alternatives	Transparency of costs, benefits and risks
	Indirect benefits	Monitoring costs
	More profitable farming opportunities	Explicit and distinct parameters
Policy / Legal	Alternative for brine	Permit granting process
	Permits in different locations	Policy framework water manager
	Policy-related interest	Monitoring and infiltration requirements
		Coordination subsurface spatial planning
		Control and enforcement
		Liability
		Brine policy

The opportunities and challenges are intertwined. Total costs fall for example with technical challenges such as recovery rate, maintenance and well obstruction. Reactions with soil (water) can be a showstopper from the geo-hydrological point of view. Policy-related requirements can stop initiatives with infeasible infiltration standards, or monitoring requirements that have major consequences for the price/m^3.

The environment in which underground water storage is located is very heterogeneous. There is no method available that offers solutions in every circumstance. Factors influencing the application are:
-the composition and thus suitability of the soil;
-policy frameworks (European, national, regional, local);
-the socio-economic conditions;
-degree of urgency;
-available alternatives for fresh water supply;
-reference framework of initiators and water managers.

There are interlinked and complementary opportunities in peak storage and surface water quality demands. Also, the current pilots can integrate with other methods of water storage/extraction, such as dynamic management of irrigation basins, reverse osmosis and climate adaptive drainage.

Fresh water storage in the subsurface can provide a significant contribution to the freshwater demand. The 'ASR coastal' method can for example meet the entire freshwater demand of all the greenhouses in Oostland (a concentrated greenhouse area in the province of Zuid-Holland). The potential of all available methods should be further examined and can be made transparent with opportunity maps.

In order to maximize the potential of decentralized underground fresh water storage in a saline subsurface knowledge development, focused on long term effects, is required. Also, defining clear policy and legal frameworks is crucial for the up scaling to a wider application. The tested methods of ASR in the focus pilots can inspire other regions in the world and have the potential to lead to opening up undiscovered possibilities to adapt to droughts.

Knowledge of realistic opportunities and challenges are not distributed evenly within the relevant/interested parties. Knowledge lays, due to the degree of heterogeneity, in the nuance. The Waterbuffer Foundation can play a valuable role when making up-to-date knowledge developments available and provide a platform for knowledge sharing.

Websites with more information

- http://knowledgeforclimate.climateresearchnetherlands.nl/climateprooffreshwater

- http://www.kwrwater.nl/page.aspx?id=8475

-http://publicwiki.deltares.nl/display/FRESHSALT/GO-FRESH+-+Promising+measures+local+freshwater+supply