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Innovative solutions to protect and increase fresh groundwater availability on small islands

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Abstract

The small island developing states (SIDS) are the first to be hit seriously by sea level rise and climate change. These small islands are prone to multiple hazards which interact and may cause large damages and reduce the habitability. Freshwater lenses are groundwater stocks below small islands and form the most important freshwater source for drinking and agriculture for many small islands. Unfortunately, these small freshwater lenses are very vulnerable and will shrink due to sea level rise, climate change (prolonged droughts) and overexploitation and will get salinized by sea water flooding more frequently.

To ensure a sustainable healthy and clean freshwater supply for people and ecosystems, the small islands require innovative and integrated solutions. Different solutions are thinkable, and the feasibility of some promising solutions focused on the increase of fresh groundwater availability are quantified with models and will be discussed. These solutions are: (1) managed aquifer recharge (MAR), (2) SeepCat, (3) sustainable groundwater extraction schemes.

(1) With MAR, groundwater recharge is increased by artificial infiltration of excess rainwater which normally flows towards the sea. Usually, there is more space in the subsoil than on land to store extra freshwater and being less prone to evaporation and pollution. (2) SeepCat provides a technical solution which consists of a series of vertical wells installed between the freshwater lens and the ocean side. Saline groundwater is extracted (by a solar pump) to prevent the freshwater lens to be pushed upwards by sea level rise and even creates more space for lenses to grow. (3) Groundwater extraction will rapidly result in saltwater upconing and undesirable elevated salinities in the pumping water. This is highly dependent on the location, depth of wells and extraction schemes in time. Scavenger wells and intermittent pumping are promising combinations for sustainable groundwater extractions.

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