Sustainable coastal groundwater management and pollution reduction through innovative governance in a changing climate

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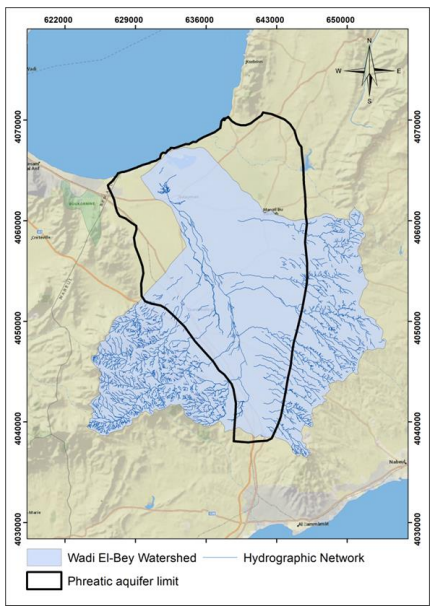
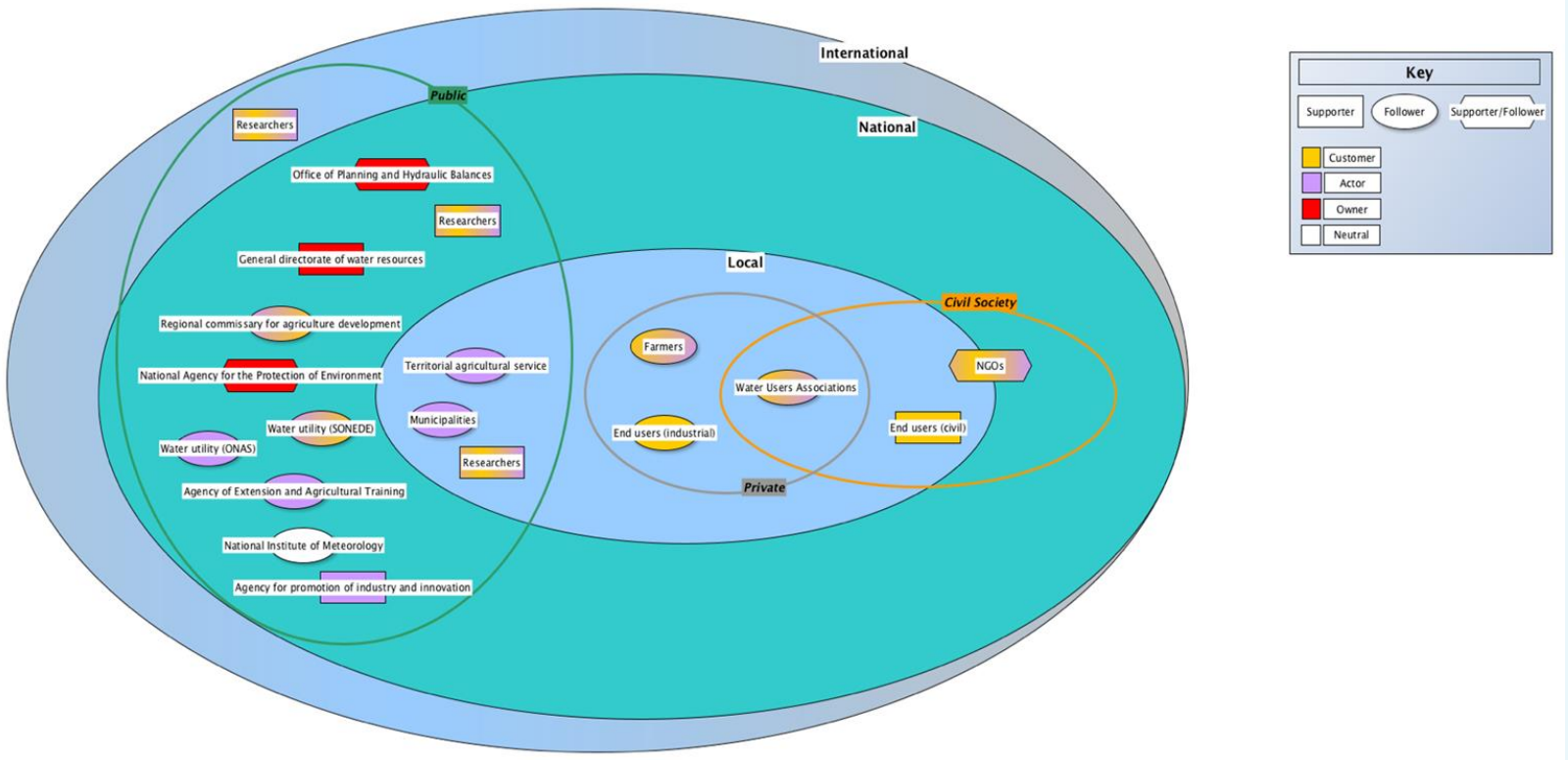


Demonstration site factsheet
Wadi El Bey, Tunisia

Description

The Wadi El Bey pilot site is located at about 40 km at the south of Tunisian capital. It extends over a surface of 430 km². It is boarded to the north by the Gulf of Tunis and the Tekelsa Hills, to the west by the BouChoucha and the Halloufa mountains, to the south by the Hammamet Hills, and to the east by the Abderrahman Mountain and the oriental coastal highlands. The main Wadi of this pilot site discharges into the El Maleh Sebkha, which is close to the MED Sea. This pilot site contains various industries operating mainly in the domain of textile, leather and agri-food. Furthermore, it contains extensively cultivated superficies of citrus, oranges, grapes, and vegetables.

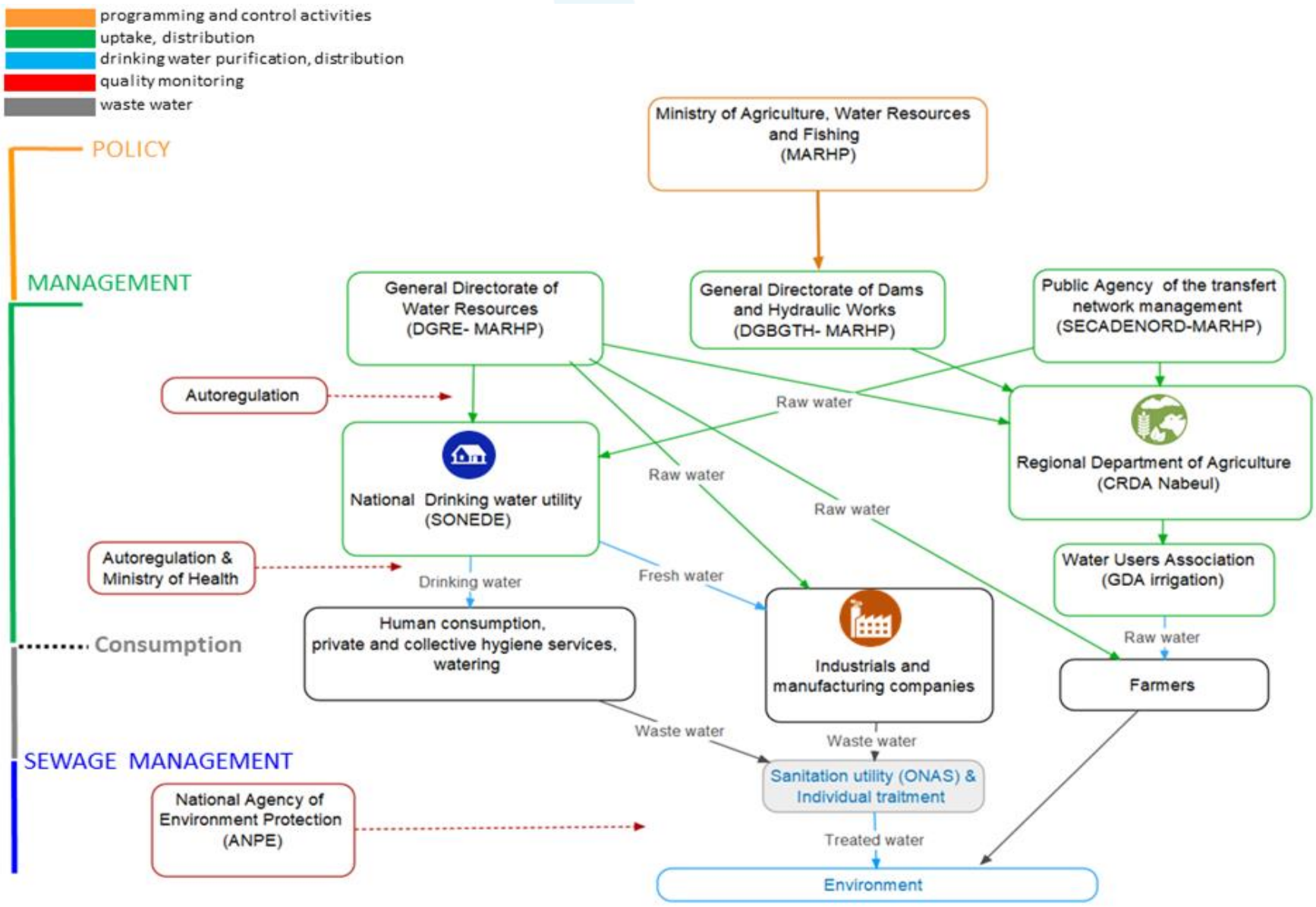
Stakeholder mapping



Sepecific problems

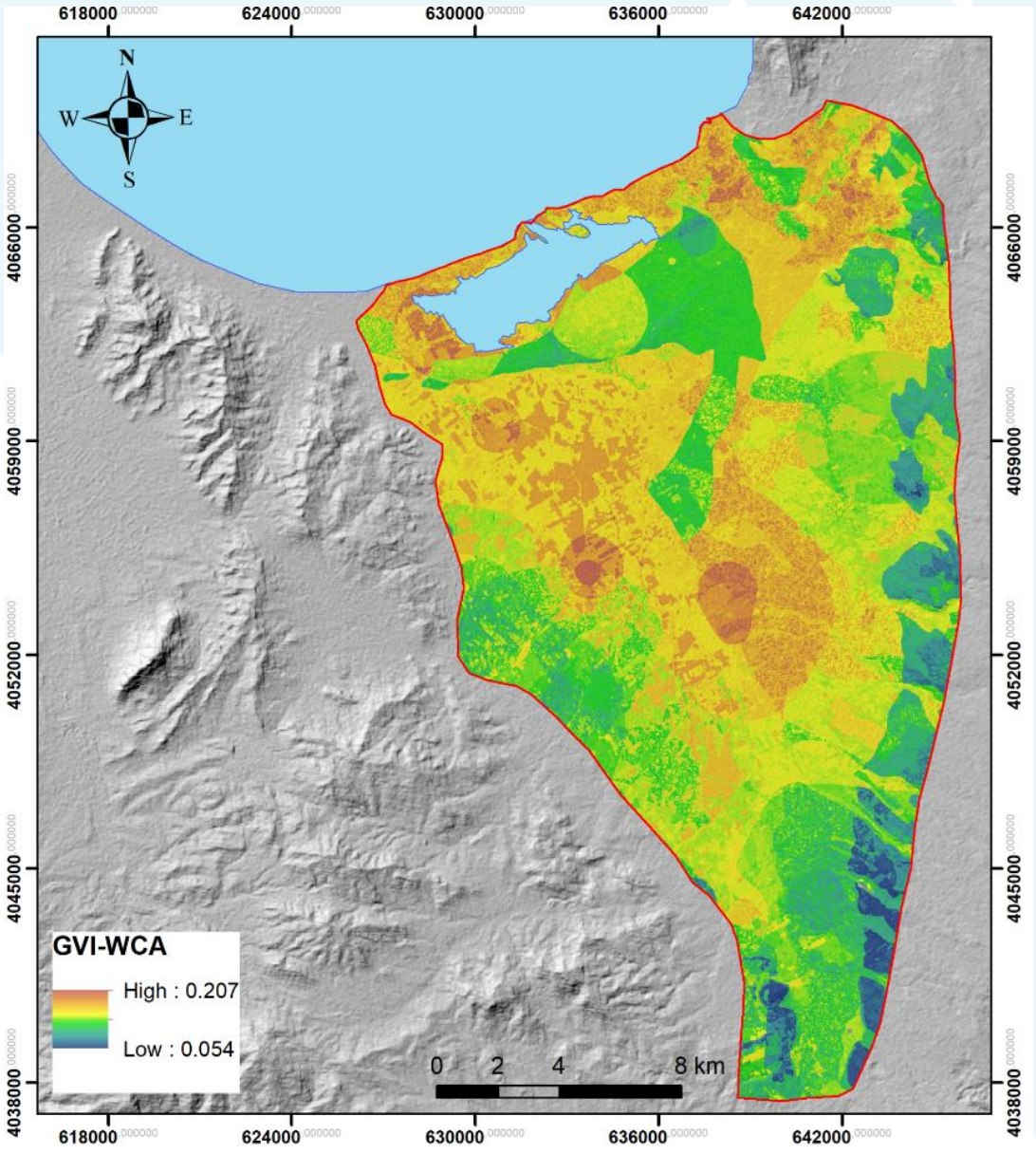
The site is characterised by a high level of pollution as a result of the important development of the industry, agriculture and tourism activities. The main sources of pollution are industrial and agricultural activities and inadequate wastewater treatment. Indeed, four wastewaters treatment plants located in the cities of Bouargoub, Grombalia, Menzel Bouzelfa, and Soliman produce annually 4 million m3 of treated wastewaters. There is a legal framework that regulates the discharge in the receiving environment, ONAS networks and water bodies according several laws. Despite this legal framework, various industries discharge their inappropriately treated wastewaters in this Wadi, which represents a serious threat on the shallow groundwater quality.

Water gouvernance system in Wadi El Bey



SUSTAIN-COAST results

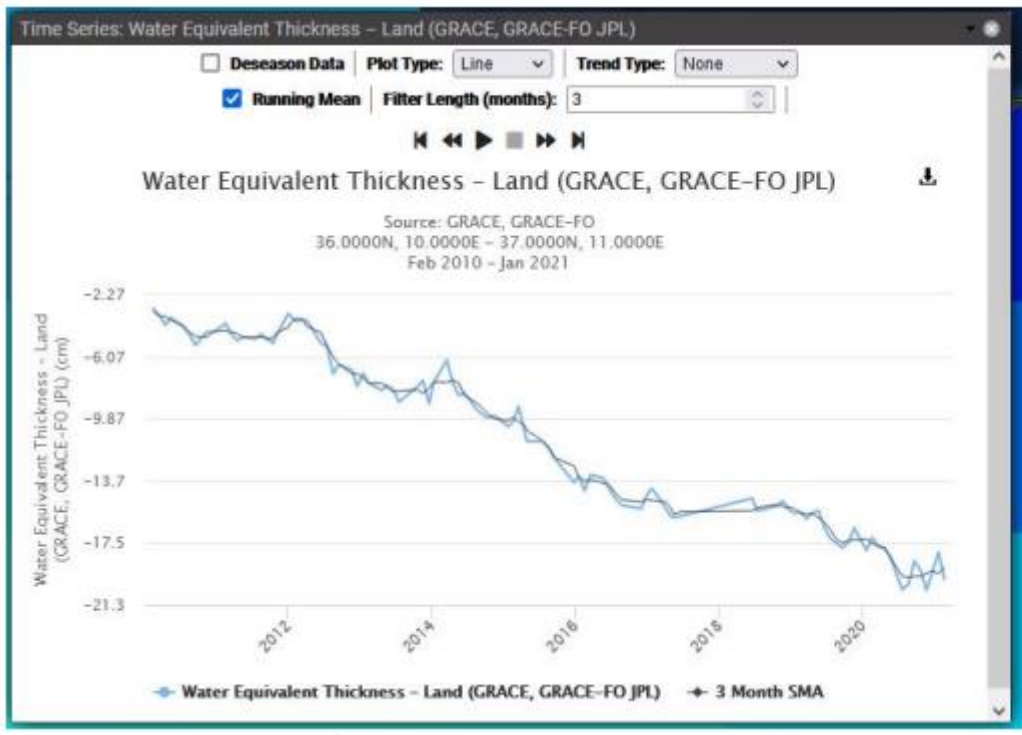
Groundwater Vulnerability Index values*

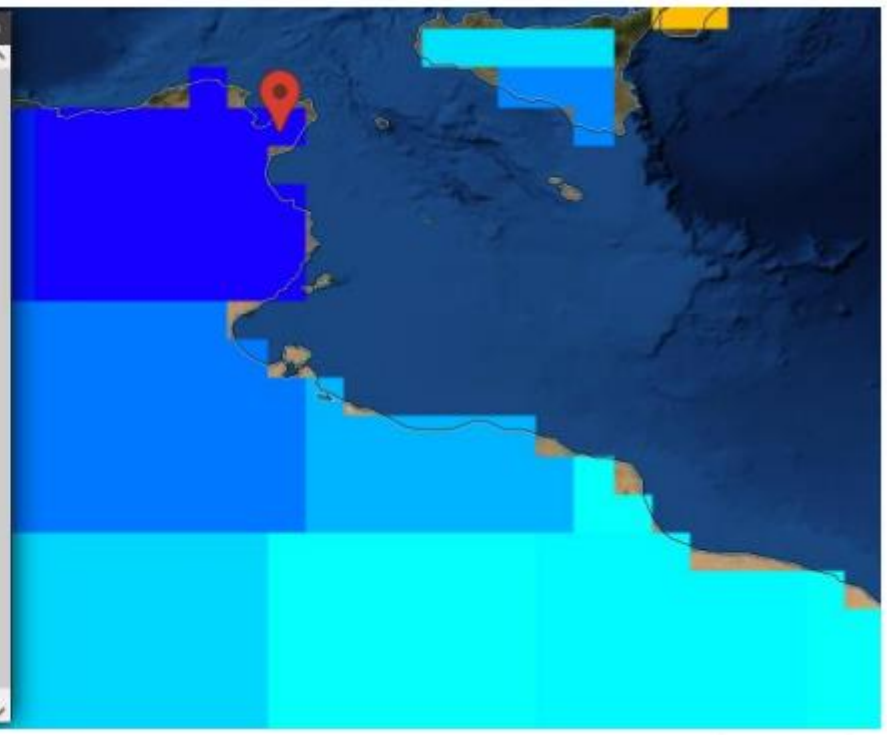


The Groundwater Vulnerability Index values of the Wadi El Bey Coastal Aquifer range from 0.054 to 0.207. The GVI values of the middle part of the ECA where the slope is low and the areas along the coastline are very high. Groundwater in these areas is more vulnerable to contamination. More than half of the study area is moderately vulnerable to pollution, while 17% is highly vulnerable. In areas highly vulnerable, the groundwater table is at shallow depths.

*The groundwater vulnerability index is a method of assessing the vulnerability of aquifers to surface contaminants

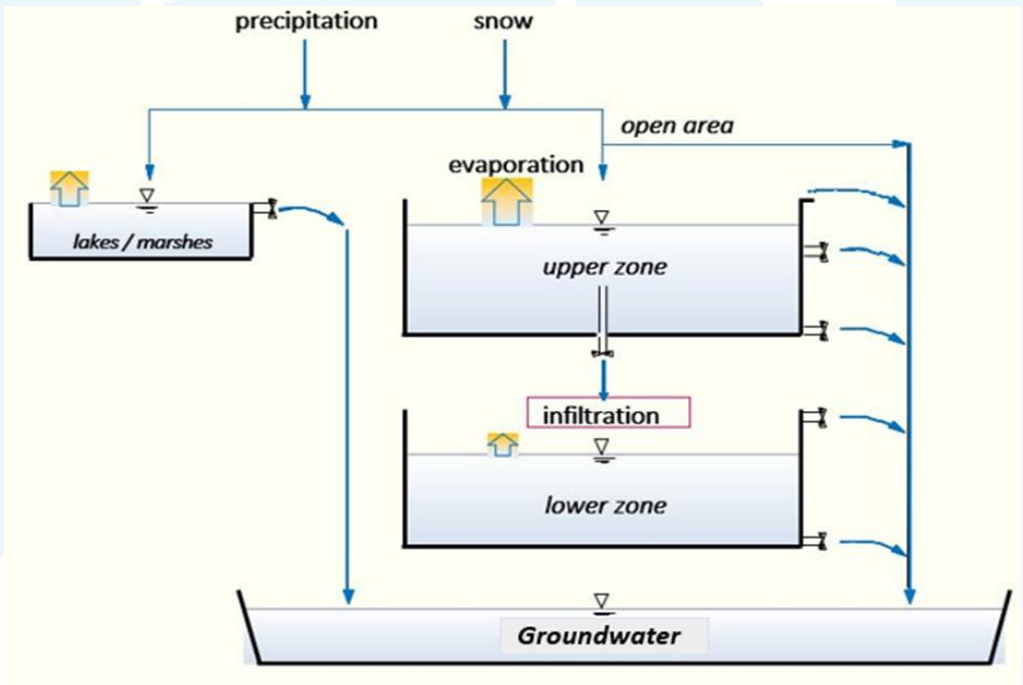
Variability of groundwater in terms of water equivalent thickness





The global database from the Gravity Recovery and Climate Experiment (GRACE) mission was used to assess the groundwater level change and implement the cost benefit analysis.

Cost- benefit analysis



Wadi El Bey, Tunisia	2021	2031	2041
Groundwater use	30%±7	36%±8	28%±7
Surface water use (reservoir)	25%±4	21%±7	25%±4
Other sources e.g., treated wastewater	45%	43%±9	47%±7
Aquifer recharge/% of groundwater use	77%±11	72% ±7	67%±15
Financial benefit compared to groundwater use only	23%	19%	23%

Considering the available information and applying the proposed cost-benefit analysis methodology, results show that beyond 14 overpumping violations were observed when groundwater is only used. However, mitigation measures (groundwater and surface water used together) are more affordable compared to intensive groundwater use only. The proposed mitigation measures consist of the balanced use of available water resources (groundwater, stream water and treated wastewater) according to the calculated values presented in the table. In addition, the projected water use balance for the next decades is presented.

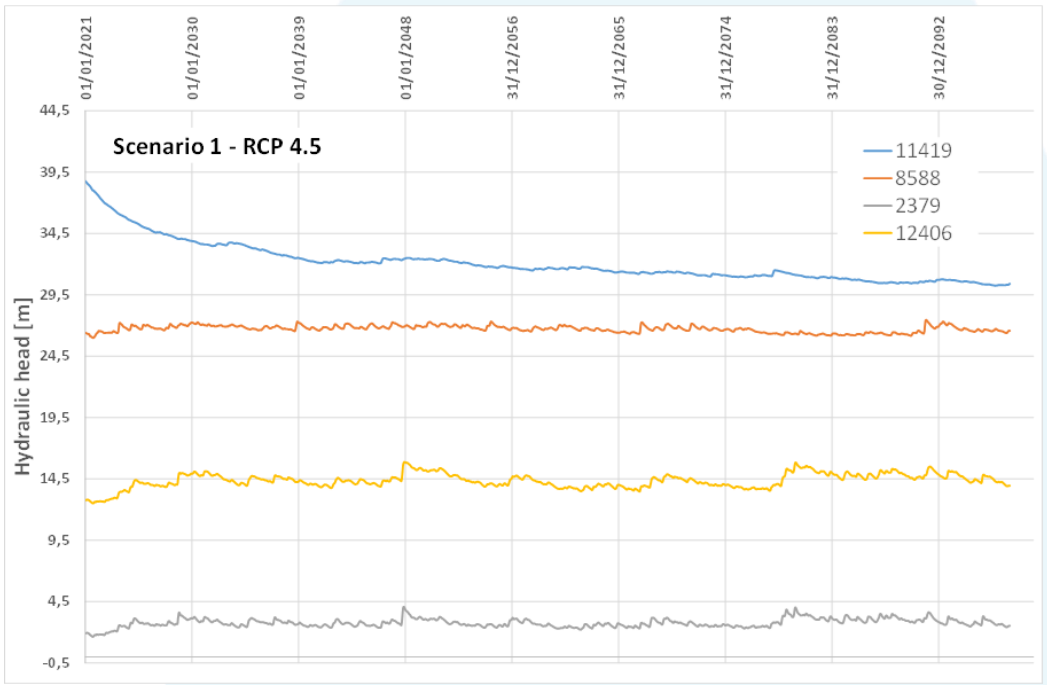
Climate change analysis

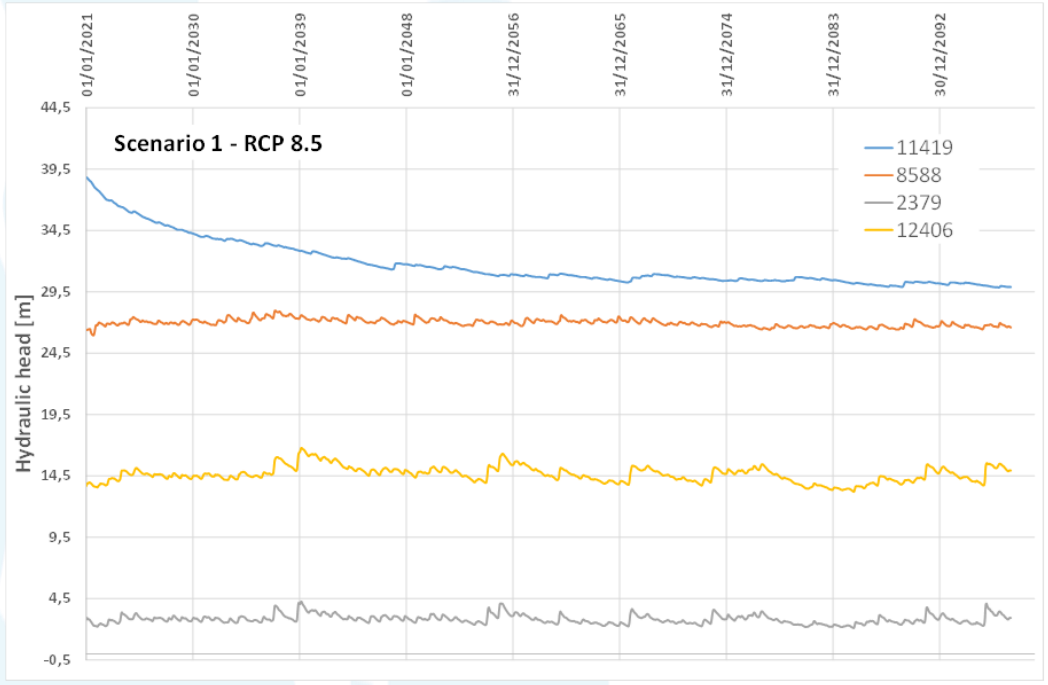
The climate scenarios, a combination of Regional Climate Models (RCMs) and General Circulation Models (GCMs) – 6 scenarios produced

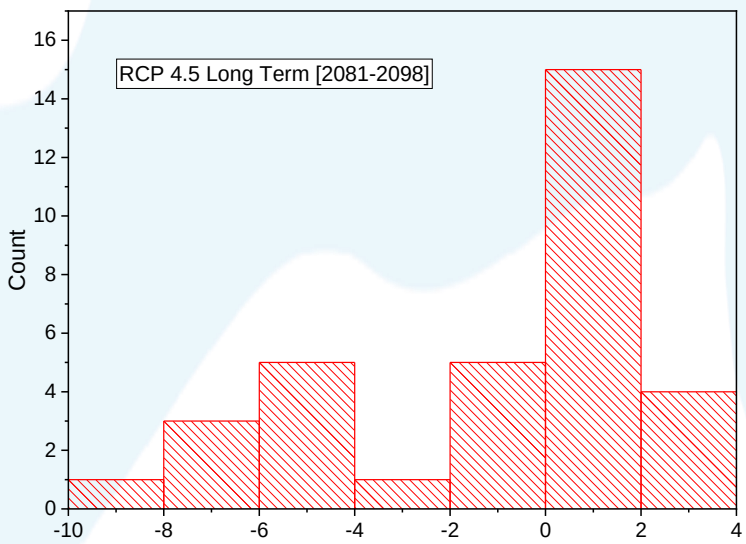
Climate scenarios were based on the Representative Concentration Pathways (RCPs) 4.5 and 8.5

Precipitation and temperature data, recorded at 4 weather stations from 1976-2005, were used to correct the systematic errors in the outputs of the Regional Climate Models

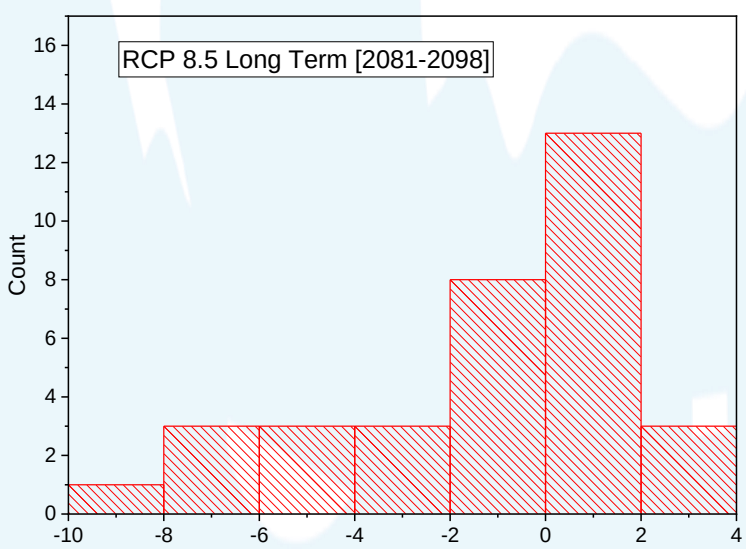
2021-2098 is the scenario period: time-variant groundwater recharge in 8 areas deduced from predicted rainfall







Location of 4 selected observation wells



Only small differences on predicted hydraulic head variations between RCP 4.5 and RCP 8.5. Climate scenario results show a bistructured north-south behavior in hydraulic heads: increase in the North, depletion in the South.

In the southern part of the study site, due to the reduced annual rainfall (-20%) predicted by the scenarios, a significant decrease of groundwater level of up to 1m is observed between 2021 and 2098. In the northern part, the predicted rainfall is in the same as today or even slightly increased:➔ hydraulic heads are either increased or stable.

A further increase of the pumping rate due the climate change would be severe for the southern part of the Wadi El Bey aquifer.

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