

Concept:
PAP/RAC and UNESCO - IHP, 2023

Contacts:
Simone Grego (UNESCO - IHP),
s.grego@unesco.org
Jose-Luis Martin-Bordes,
jl.martin-bordes@unesco.org

Coordinator:
Veronique Evers (PAP/RAC)

Illustrations and design:
Luka Duplančić

In the framework of the GEF
MedProgramme
Child Project 2.1



COASTAL AQUIFERS THE INVISIBLE TREASURE

Most groundwater, including an important part of the water we are drinking, comes from aquifers. Their protection should be our priority.



Why are coastal aquifers and groundwater important?

The availability and quality of freshwater resources is a critical issue for the growing population of the coastal areas in the Mediterranean basin. Water demand in the region doubled during the second half of the 20th century and is now an aggregate of 290 km³ per year. Coastal aquifers are of particular importance to respond to this increasing demand. They often represent the main source of freshwater for human uses including drinking, agriculture and industrial needs. However, these invisible key resources face numerous challenges such as: growing pressure on groundwater supplies, saltwater intrusion, coastal aquifer salinization, and nutrient and contaminant transport.

As recognized by the Mediterranean Sea Transboundary Diagnostic Analysis (TDA) Coastal Aquifer Supplement of 2012, coastal aquifers contribute to the integrity and functioning of the coastal zone and marine ecosystems, and their degradation contributes to the major transboundary issues affecting the Mediterranean Sea Large Marine Ecosystem (LME).

The regional picture that emerges from the assessment of the current state of these critically important resources is one of environmental stress, generalized neglect and progressive degradation of coastal aquifers and coastal freshwater ecosystems along large sections of the Mediterranean coastline.

Management frameworks for coastal groundwater are absent, and in many cases these resources are not formally recognized as critical for the sustainability of coastal developments, and as being highly vulnerable. Unregulated exploitation is common, and no quality-quantity safeguards exist or are applied. Conflicts among uses (agriculture, domestic, tourism, environment, energy...) are common and potentially disruptive.

Additionally, scientific knowledge and public awareness on coastal aquifers are scanty or non-existent in most countries. Monitoring is occasional at best, but lacks modern technologies and strategic, multi-purpose design.

Coastal aquifers: a freshwater system in dynamic interaction

COASTAL AQUIFERS AND THE COASTAL ZONE

Coastal aquifers and Integrated coastal zone management (ICZM) are closely intertwined, with their linkages playing a crucial role in the sustainable development and preservation of coastal areas. Effective coastal zone management recognizes the significance of these aquifers and seeks to ensure their sustainability by implementing measures to prevent over-extraction, pollution, and saltwater intrusion. Indeed, coastal areas are susceptible to various forms of pollution, such as runoff from agricultural activities, urban development, and industrial discharges. If left unmanaged, these pollutants can infiltrate into the underlying aquifers, compromising their quality and potability. By implementing coastal zone management practices, such as the regulation of land use, the implementation of best management practices, and the establishment of buffer zones, the potential risks of contamination can be minimized, thereby safeguarding the coastal aquifers' health and productivity.

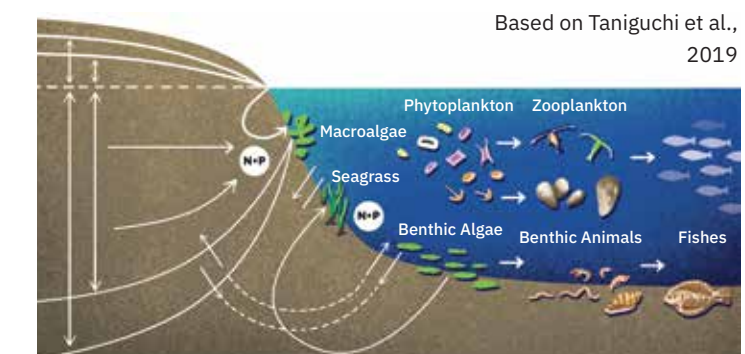
Another significant linkage between coastal aquifers and coastal zone management is the mitigation of coastal hazards. Coastal areas are prone to natural disasters, including storm surges, flooding, and sea-level rise. These events can have detrimental impacts on coastal aquifers, leading to salinization and intrusion of saltwater into freshwater aquifers. Proper coastal zone management approaches, such as the construction of protective structures like seawalls, dikes, and recharge basins, can help reduce the vulnerability of aquifers to these hazards. Additionally, preserving and restoring natural coastal ecosystems, such as wetlands and dunes, through coastal zone management can provide natural buffers that protect aquifers from the impacts of extreme weather events.



COASTAL AQUIFERS AND THE MARINE SYSTEM

Seawater intrusion is the movement of seawater into freshwater aquifers due to natural processes or human activities. Seawater intrusion is caused by decreases in groundwater levels or by rises in seawater levels. Intrusion affects the quality of water and the health of groundwater dependent ecosystems. Coastal aquifers play a role in reducing the impacts of saltwater intrusion. Rising sea levels can lead to the intrusion of saltwater into freshwater resources, making them unsuitable for consumption or irrigation. However, coastal aquifers act as a natural barrier against saltwater intrusion, maintaining a freshwater lens beneath the land surface. By carefully managing groundwater extraction and implementing measures to prevent over-pumping, such as implementing water-use efficiency practices, coastal communities can preserve the integrity of their aquifers and ensure a reliable supply of freshwater.

Although Submarine Groundwater Discharges (SGD) are large (>25%) in the Mediterranean, and in places superior to surface water inflows, they have not been sufficiently characterized and assessed in many coasts of the Mediterranean basin. Hence coastal aquifers contribute to, and sustain shallow marine water quality and ecosystems. Nutrients such as nitrates and phosphates in coastal aquifers are a serious concern in some parts of the Mediterranean. Excess nutrients in water have led to water quality problems such as algal blooms, eutrophication in a number of surface water bodies, affecting living marine resources and human health.



COASTAL AQUIFERS AND GROUNDWATER-DEPENDENT ECOSYSTEMS (GWDE)

Coastal aquifers often support unique and diverse ecosystems, including wetlands, estuaries, lagoons, humid zones and other coastal habitats which are critical habitats for various plant and animal species. Some of these ecosystems which provide very valuable services and contribute to coastal livelihoods, are all in part or totally dependent on groundwater regimes. The services provided by GWDE include: freshwater, food, fiber, medicines, minerals, construction materials, improvement of water quality, regulation of climate, generation of tourism, economic resources, cultural values, etc.

Despite the irreplaceable contribution to human wellbeing, many Mediterranean coastal ecosystems have been destroyed or irreversibly damaged, and even at present they are subject to many pressures, which cause significant economic, social and environmental losses, and qualitative and quantitative impairment of water resources.

Coastal zone management practices that promote conservation and restoration of these ecosystems contribute to the protection of aquifer recharge areas and the maintenance of groundwater quality. By recognizing the interdependencies between coastal aquifers and ecosystems, coastal zone management can adopt an integrated approach that ensures the long-term health and resilience of both.



COASTAL AQUIFERS AND ADAPTATION TO CLIMATE CHANGE

Coastal aquifers play a crucial role in adaptation to climate change, particularly in mitigating the impacts of rising sea levels and changing precipitation patterns. As global temperatures rise, sea levels are increasing, posing a significant threat to coastal communities and ecosystems. In this context, coastal aquifers act as natural buffers and can contribute to adaptation strategies in several ways.

Coastal aquifers serve as natural storage systems for freshwater. As climate change alters precipitation patterns, some coastal areas may experience increased droughts or shifts in rainfall intensity. Coastal aquifers can help to mitigate water scarcity by storing excess rainfall during periods of heavy precipitation and providing a reserve of freshwater during dry spells. This stored water can support various needs, including drinking water supplies, agriculture, and ecological habitats, thus enhancing the resilience of coastal communities in the face of changing climate conditions.

Coastal aquifers also contribute to the maintenance of coastal ecosystems by sustaining groundwater flow to support vegetation and maintain ecological balance. Preserving and restoring these coastal ecosystems through adaptive management practices can help enhance their resilience and contribute to climate change adaptation efforts.

Key messages

~ The sustainable management of coastal aquifers is essential for providing freshwater resources, mitigating coastal hazards, preserving ecosystem integrity, and protecting human livelihoods in coastal areas.

~ Effective coastal zone management practices are vital for safeguarding the health and productivity of aquifers, preventing pollution and saltwater intrusion, and promoting the overall sustainability of coastal regions.

~ Recognizing and addressing these linkages is crucial for achieving integrated and holistic approaches to coastal development and conservation, ultimately contributing to the resilience and well-being of both coastal aquifers and the communities they serve.

What can we do to preserve these strategic resources?

~ Enhancing cooperation amongst a keyholders is crucial for the preservation of coastal aquifers in the Mediterranean. Given the shared nature of the seaquifers, collaboration among countries, local communities, scientists, policy makers, and other relevant actors is essential. Effective coordination can facilitate the exchange of knowledge, data, and best practices, leading to informed decision-making and the development of integrated management strategies. Collaborative initiatives can promote sustainable water use, pollution prevention, and the protection of recharge areas. By fostering dialogue and joint action, stakeholders can work together to ensure the long-term viability of coastal aquifers in the Mediterranean region, safeguarding this invaluable resource for present and future generations.

~ UNESCO is the Executing Partner in charge of the implementation of Component 2 on “Management of Coastal Aquifers and Related Ecosystems” of Child Project 2.1 of the UNEP/GEF MedProgramme. Five priority coastal aquifers are being characterized and assessed, namely i) Rhiss-Nekkor in Morocco, ii) Ras Jebel in Tunisia, iii) Jifarra Plain in Libya, iv) Damour in Lebanon and v) Buna/Bojana shared by Albania and Montenegro.

~ In the framework of Child Project 2.1 of the MedProgramme, two collaborative initiatives are being implemented by the executing partners:

- *Integration of the coastal aquifer of Rhiss-Nekkor in the Tangier-Tetouan-Al Hoceima's ICZM Plan in Morocco, led by PAP/RAC.*

- *Joint preparation of an Integrated Management Plan for the Damour area in Lebanon, led by GWP-Med, UNESCO, PAP/RAC and Plan Bleu/RAC.*

Illustration is adapted from:
Corson-Dosch et al., 2022,
The Water Cycle



1 Groundwater recharge
2 Groundwater
3 Atmospheric moisture over land

4 Evapotranspiration
5 Support for vegetation and ecological balance
6 Vegetation cover as a filter

7 Precipitation over land
8 Soil moisture
9 Adaptation to climate change: Natural storage for freshwater, Storing excess rainfall

10 Runoff
11 River
12 Grazing water use

13 Support for unique and diverse ecosystems including wetlands, estuaries, lagoons
14 Drinking water
15 Atmospheric moisture over sea

16 Streamflows
17 Precipitation over sea
18 Sea evaporation

PRESSURES ON GROUNDWATER AGGRAVATED BY ANTHROPOGENIC ACTIVITIES
1 OVEREXTRACTION
2 SALTWATER INTRUSION

3 LANDFILLS
4 URBAN IMPACTS
5 SUBMARINE GROUNDWATER DISCHARGES
6 INDUSTRIAL DISCHARGE