

Climate change and the Water-Energy-Food-Ecosystems (WEFE) nexus

in the Mediterranean Basin

Cradle of ancient civilisations, The Mediterranean Basin encompasses diverse cultures, climates, and ecosystems. The Mediterranean climate, marked by hot, dry summers, and mild, wet winters, supports rich biodiversity and fertile lands.

The Mediterranean is a climate change hotspot where both human societies and ecosystems face high exposure and vulnerability. Population and economic growth, agricultural intensification, urbanisation, pollution, and unsustainable resource management impact the level of insecurity for water, energy, food, and ecosystems (WEFE), putting the capacity of Mediterranean countries to reach the Sustainable Development Goals (SDGs) of the 2030 Agenda at risk.

The **WEFE nexus approach** provides a comprehensive framework to address challenges in the development of sustainable solutions and the prevention of detrimental cascading effects that could further harm the region's communities and ecosystems.

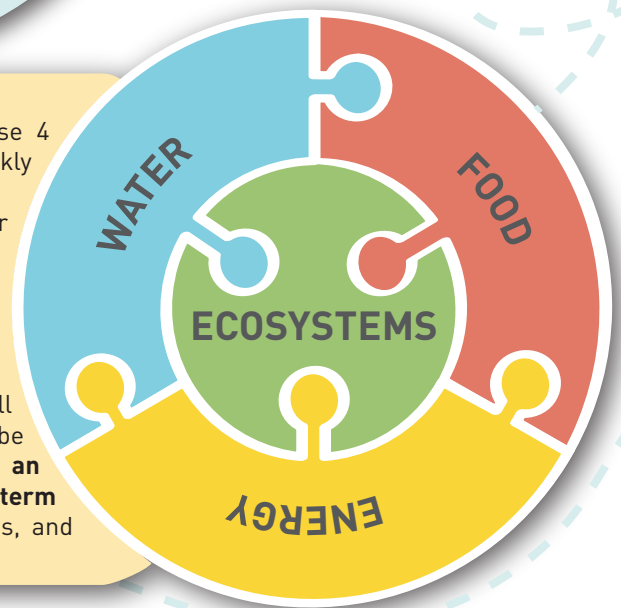
NEXUS (noun): a connection or series of connections linking two or more things.

Importance of the WEFE nexus

The WEFE nexus concept highlights the interdependence of these 4 critical sectors, in any of which mismanagement or crisis can quickly ripple across others, for example:

- Water-Energy ties: reduced river flows lower hydropower production and may force energy systems to rely on fossil fuels, increasing costs and emissions.
- Water-Food-Ecosystem connections: over-irrigation depletes groundwaters, harming ecosystems that support biodiversity, pollinators, and agriculture.

A nexus approach integrates the analysis of interactions between all WEFE components to identify trade-offs and co-benefits that might be overlooked in single-sector approaches. **Implementing such an approach in the Mediterranean would help promote long-term sustainability for 500 million inhabitants, ensure equitable access, and prevent resource conflicts.**



Key facts & figures

- The Mediterranean region is experiencing significant warming, with air temperatures **already 1.5°C above** pre-industrial levels.
- Seawater temperatures are **rising twice faster** than globally, rising 0.29°C–0.44°C per decade since the early 1980s.

- The energy sector is the most responsible for climate change in the Mediterranean, accounting for **76%** of total regional greenhouse gas (GHG) emissions.
- Energy production accounts for **30%** of the fossil energy emissions.
- The dynamics of energy demand are expected to shift around the Mediterranean Basin.

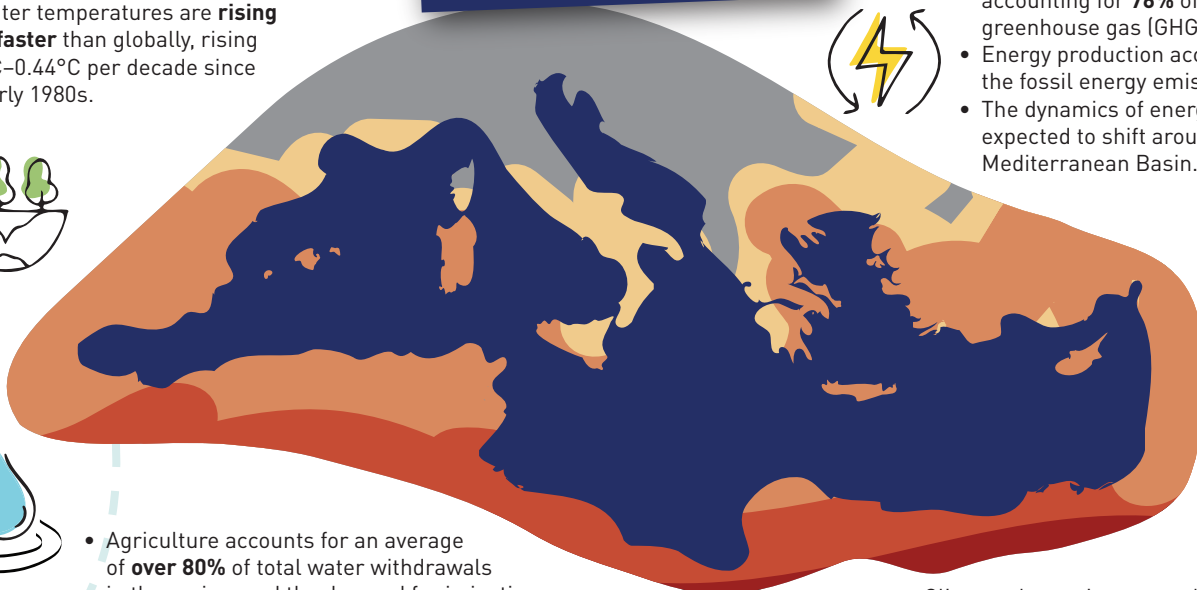


- Agriculture accounts for an average of **over 80%** of total water withdrawals in the region, and the demand for irrigation is expected to increase by **up to 18%** by 2100.
- **180 million people** in the Mediterranean already suffer from water scarcity, with the per capita availability of renewable water having declined 68–78% between 1962 and 2017.

- Climate change is expected to impact crop yields, with a **17% reduction** forecast for the Mediterranean in the next decades.
- **High dependency on food imports**, particularly for Middle Eastern and North African countries, makes the region highly vulnerable to external uncertainties.

Drought level

High
Low



Interconnections & cascading effects

The interactions between WEFE components can result in cascading effects where disruptions in one element lead to changes in others, generating multiple looping feedback paths.



- Inefficient irrigation practices can exacerbate water scarcity and lead to reduced crop yields and food insecurity.
- Climate-induced changes in precipitation patterns strain water availability for agriculture.
- Energy production needs water. Shortages can disrupt power generation.



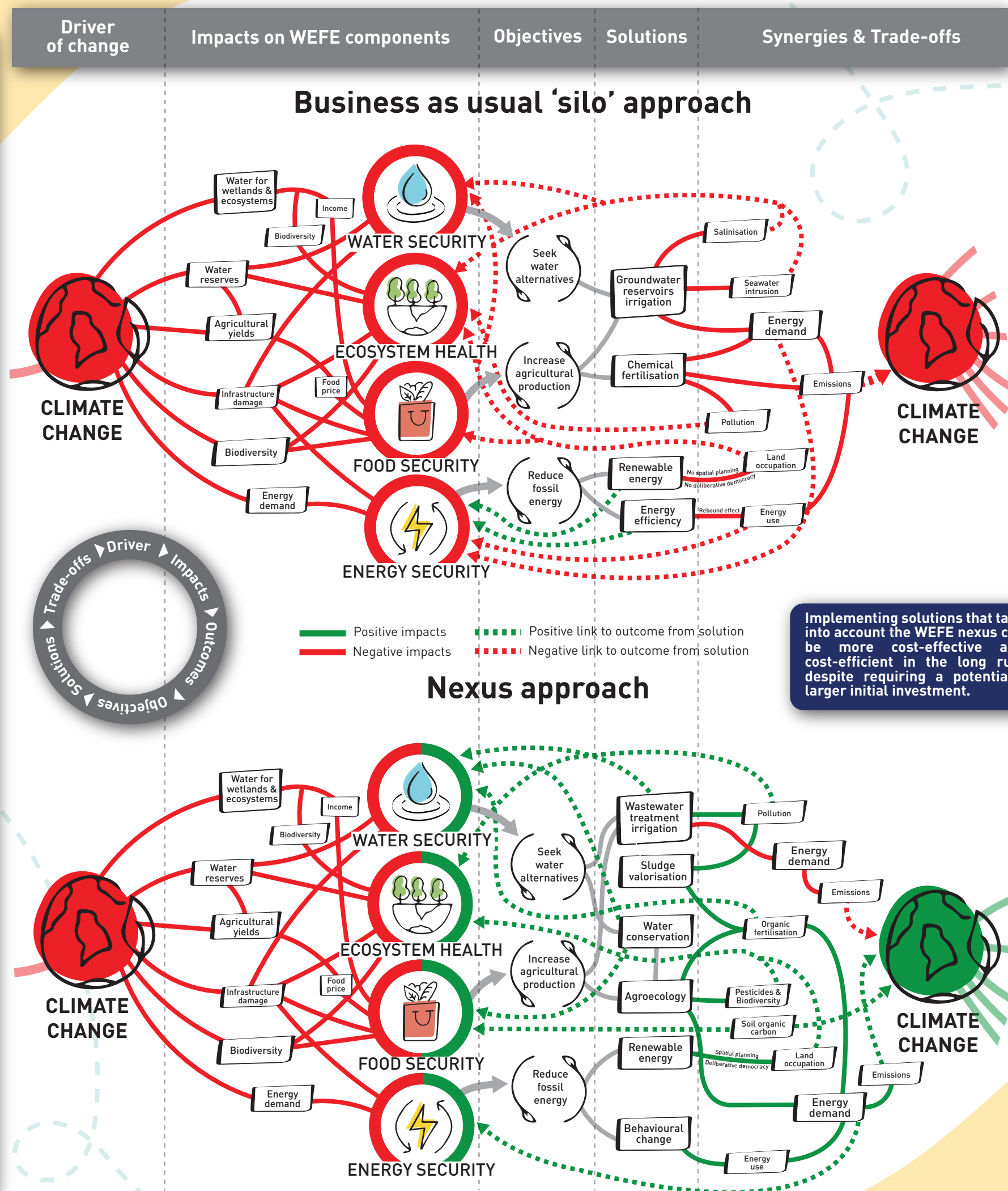
- Overexploitation of water and land for agriculture and energy production can lead to biodiversity loss and diminished natural services, in turn affecting agricultural productivity and energy sustainability.
- Biodiversity loss and ecosystem degradation negatively affect soil structure and fertility, reducing agricultural yields.



- Improving agricultural yields through irrigation and chemical fertilisation might result in increasing competition for water resources.
- Agricultural intensification and the increased consumption of animal-based products are responsible for an increase in GHG emissions.
- Expanding bioenergy crops may compete with food crops for resources.



- Rising energy costs can increase food production expenses and prices.
- Water production and distribution depend on energy for pumping, treatment, and distribution, while energy shortages can impede water services, creating a feedback loop of resource insecurity.
- Renewable energy promotion can lead to increased land competition.
- Improving energy efficiency may paradoxically result in increased energy use (rebound effect).



EXPLORING SOLUTIONS for sustainable management

A nexus approach to adaptation and mitigation actions promotes synergies between the WEFE components and minimises potential trade-offs.



Integrated resource management

Improved irrigation could save up to 35% of water. With 2°C warming, agricultural droughts may become 150–200% more frequent in southern countries.

Integrated management links water, energy, food, and ecosystems. Adaptation actions like planting drought-resistant crops reduce water use and enhance food security. Using renewable energy in agriculture is a successful mitigation measure.



Technological innovation

Renewables made up only 11% of total energy consumption in 2020. Projected streamflow declines could reduce hydropower and thermoelectric output by up to 7% and 15% respectively by the 2050s.

Solar-powered desalination and agrivoltaics can optimize energy use if supported by spatial planning and public consultation. Renewable energy in the Mediterranean supports water, ecosystems, food, and energy—when it avoids high environmental costs and resource degradation.



Nature-based solutions

Between 2002 and 2009, average fertiliser consumption in 21 Mediterranean countries, mainly in the Euro area, was 188 kg.ha⁻¹, higher than the worldwide average (116 kg.ha⁻¹ of arable land).

Agroecological practices in the Mediterranean involve biodiversity and crop diversity management, increasing soil organic matter, reducing fossil fuel dependence, managing extensive herds, using local breeds, and pasture and forage management. These practices enhance adaptation to climate change and ecosystem services, while reducing GHG emissions.



Social innovation & behavioural change

Western-style industrialised diets have been identified as drivers of the region's ecological deficit, including increased GHG emissions, changes in land use, energy use, and water use. On average, the ecological footprint of food production in the Mediterranean has increased by 47.4% while the biocapacity has decreased by 36.4%.

Greater adherence to the Mediterranean diet could cut GHG emissions by 72%, land use by 58%, energy use by 52%, and water use by 33%.

POLICY IMPLEMENTATION

In the Mediterranean context, **understanding and managing interconnections is vital** due to the region's environmental sensitivities and socio-economic challenges. Addressing the WEFE nexus is essential for promoting sustainable development, ensuring resource security, and enhancing resilience against climate-related impacts.

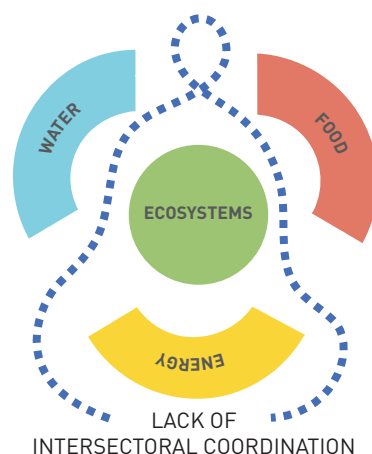
Embracing the WEFE nexus approach in policy-making offers several advantages:

- **Enhanced resilience:** integrated policies can build resilience against the impacts of climate change by promoting sustainable resource use and reducing vulnerabilities across sectors.
- **Economic efficiency:** coordinated strategies can optimise resource allocation, reduce costs, and stimulate a sustainable economy.
- **Social equity:** inclusive policies ensure equitable access to water, energy, and food resources, addressing socio-economic disparities.

Governance incorporating the WEFE nexus requires strengthened connections and better coordination, coherence, and collaboration between all actors, rather than the creation of new institutions.

Deliberative democracy can help achieve this. Identifying independent and overlapping key state and non-state actors is crucial: governments, local and regional authorities, civil society organisations, private sector, citizen groups, funders, multilateral and regional organisations, national and international research institutions, and development agencies.

SILO APPROACH



NEXUS APPROACH



KEY TAKEAWAYS



Water is pivotal in the Mediterranean and should be at the core of all climate-related policies.



Nature-based solutions and behavioral change have the most positive impacts.



Scientific data is essential, its collection and availability need to be facilitated.

IN CONCLUSION

The Mediterranean Basin faces intricate challenges at the intersection of water, energy, food, and ecosystem health, intensified by climate change. **Implementing the WEFE nexus framework is imperative to navigate these complexities.** Through the use of integrated management, technological innovation, nature-based solutions and coherent social and behavioural policies, the region can achieve sustainable development, safeguard its rich natural heritage, and enhance the well-being of its populations.



Read the full report

This overview, providing a snapshot of the links between climate change and the WEFE nexus, is based on a comprehensive scientific and technical assessment by the MedECC. For more detailed information, including the full report and further insights into the work of MedECC, please visit the following link:

www.medecc.org

