

SALAM-MED: Nature-Based Solutions for Sustainable Olive Orchard Management

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Three years of innovation and impact at the Greek Living Lab

Olive orchards across the Mediterranean are increasingly affected by climate change and unsustainable farming practices. The region is becoming warmer and drier in recent decades, with more frequent droughts and irregular heavy rainfall events (Tanasijevic et al., 2014). Projections suggest that nearly half of current olive-growing areas could experience major productivity declines as heatwaves intensify and rainfall decreases (Zagaria et al., 2023). In western Greece, for example, temperatures may rise by around 1.5 °C and annual precipitation could drop by 12% by mid-century, increasing drought stress on olive trees (Nastos et al., 2013). At the same time, intensive agricultural practices such as frequent tillage and herbicide use are degrading soils, leading to erosion, nutrient loss, and runoff. Furthermore, the uncontrolled use of groundwater for irrigation increases these pressures, as over-abstraction lowers water tables, encourages seawater intrusion in coastal aquifers, and exacerbates water scarcity during dry periods. Together, these factors threaten both the yield and quality of olives across semi-arid regions. Building Resilience Through Sustainable Practices Addressing these challenges requires integrated solutions that combine modern technology with nature-based approaches to strengthen ecosystem resilience. Maintaining vegetative ground cover, for instance, helps the soil retain moisture, reduces erosion, and protects orchards from climate extremes. The SALAM-MED Project (Sustainable Approaches to Land and Water Management in Mediterranean Drylands) has been testing such solutions over the past three years. Through living lab field trials in Messenia (Greece), the project has developed practical strategies to enhance soil health and

productivity.

Keep the soils alive: Soil erosion experiment at the Greek LL

Healthy soils are the base of resilient olive orchards, especially on hilly terrain vulnerable to erosion, a feature common across Mediterranean landscapes. The Greek Living Lab's soil management experiment demonstrated how ground cover and soil care directly influence erosion control, water retention, and long-term soil fertility. Three soil management strategies were compared on 16% slope olive groves: (1) conventional bare soil with herbicide use, (2) natural vegetation allowed to grow and mowed once per season, and (3) sown winter cover crops (a mix vicia, peas and wheat) mowed and left as mulch. The findings indicate that cover crops not only enhance soil structure and reduce erosion but also lead to higher mean carbon accumulation and greater abundance of soil arthropods. Overall, sustainable management practices, such as maintaining ground cover or sowing cover crops, demonstrated a positive effect on carbon sequestration and the diversity of soil species assemblages. These improvements support the provision of key ecosystem services, such as soil fertility, biodiversity conservation, and climate regulation, while delivering tangible benefits to rural stakeholders and local agroecosystems.

Every drop counts: Irrigation experiment at the Greek LL

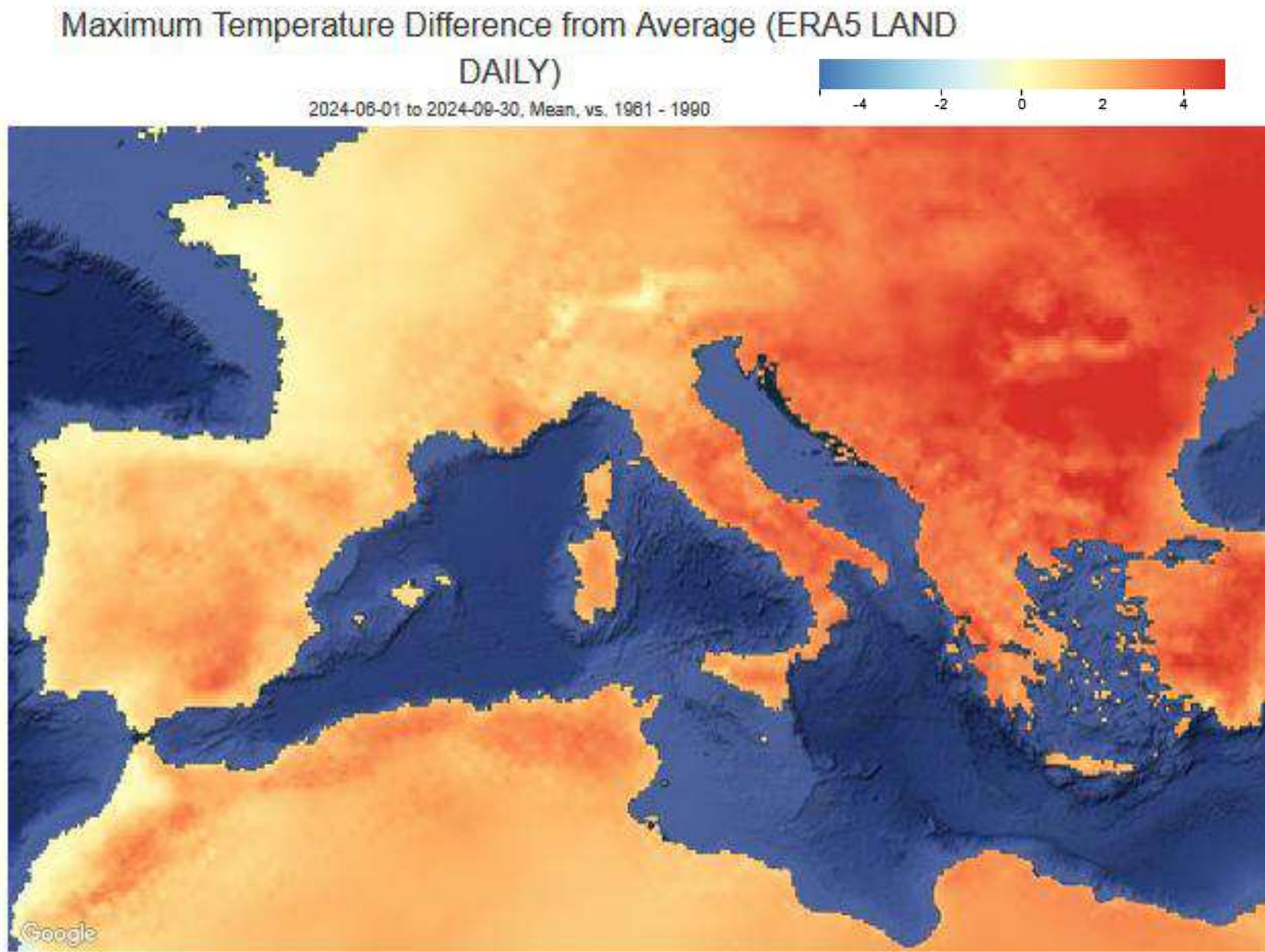
Efficient water use is essential for sustaining olive orchards under Mediterranean drought conditions. The Greek Living Lab's water management experiment explored how synchronizing irrigation with the olive tree's phenological stages can optimize resource use and strengthen climate resilience. Three irrigation practices were compared in drip-irrigated groves: (1) the farmer's conventional periodic watering, (2) a phenology-based schedule guided by key growth stages and local climate data, and (3) a fully rainfed control. This approach integrates soil moisture and evapotranspiration monitoring to deliver water precisely when trees need it most, such as during flowering, fruit set, and fruit development, while reducing irrigation

phenology-driven irrigation can enhance water efficiency, sustain productivity, and support adaptive management in olive cultivation under increasing drought and heat stress.

Key Findings

- ❖ Phenology-based irrigation (Pbl) uses evapotranspiration and crop phenology data to optimize watering only during critical growth stages.
- ❖ Pbl reduced water use by ~20% compared to conventional irrigation, requiring about ≈2,000 m³/ha per season
- ❖ In 2024, a very dry year, Pbl trees produced about 40% oil, while rain-fed trees had only 27%, a 13% higher oil content, meaning Pbl trees made more than 40% oil under drought conditions.
- ❖ Pbl produces tastier, longer-lasting, and nutritionally richer extra virgin olive oil even under drought

- ❖ The herbicide-treated plot suffered almost 4.5 times more soil loss than the cover crop plot and about 2.5 times more than the plot with natural vegetation, showing the strong erosion protection provided by plant cover.
- ❖ Over two years, soil organic carbon ranged from 0.8-1.82%, with higher averages in cover crop (1.36%) than in spontaneous vegetation (1.05%) and herbicide (0.95%), showing a significant increase in cover crops and a decrease in herbicide-treated soils by the second year.
- ❖ Cover crops support beneficial insects, pollinators, and soil organisms



Maximum temperature anomalies across Europe and the Mediterranean for summer 2024 (June-September), relative to the 1981-1990 average.



FLOWERING
March to April,
improves flower
formation



FRUIT SET
May,
enhance olive fruit
growth



PIT HARDENING
June,
optimize fruit
expansion



YIELD FORMATION
August-October
increase oil content
before ripening

Critical irrigation periods for olive growth and yield.

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