

POLICY BRIEF

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Artificial Water Basins in Sicily: Productivity Gains without Drought Resilience

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Highlights

1. Artificial water basins in Sicily currently function as productivity infrastructure rather than resilience infrastructure.
2. Effects are highly heterogeneous across crops and provinces, suggesting that agronomy, spatial context, and governance jointly shape outcomes.
3. Vegetation indicators (NDVI and VHI) are consistently higher in irrigated areas, even after controlling for seasonal and annual variation.
4. Improving operational efficiency and data transparency is needed to generate higher returns than further infrastructure expansion in underperforming provinces.

Due to climate change, the frequency, duration, and severity of drought in the Mediterranean regions are on the rise, threatening the sustainability of water resources in the region. It is projected that the Mediterranean region will experience between 55 and 125 months of drought conditions between 2021 and 2060 (Essa et al., 2023).

Summers in Sicily are long and hot, with very uneven rainfall, making water supply a limiting factor for farming. To respond to drought conditions, a network of artificial water basins, reservoirs, and canals has been built over the decades (Figure 1). These irrigation consortia (ConSORZI di Bonifica) manage basins that store water during wetter months and release it during the agricultural peak in summer.

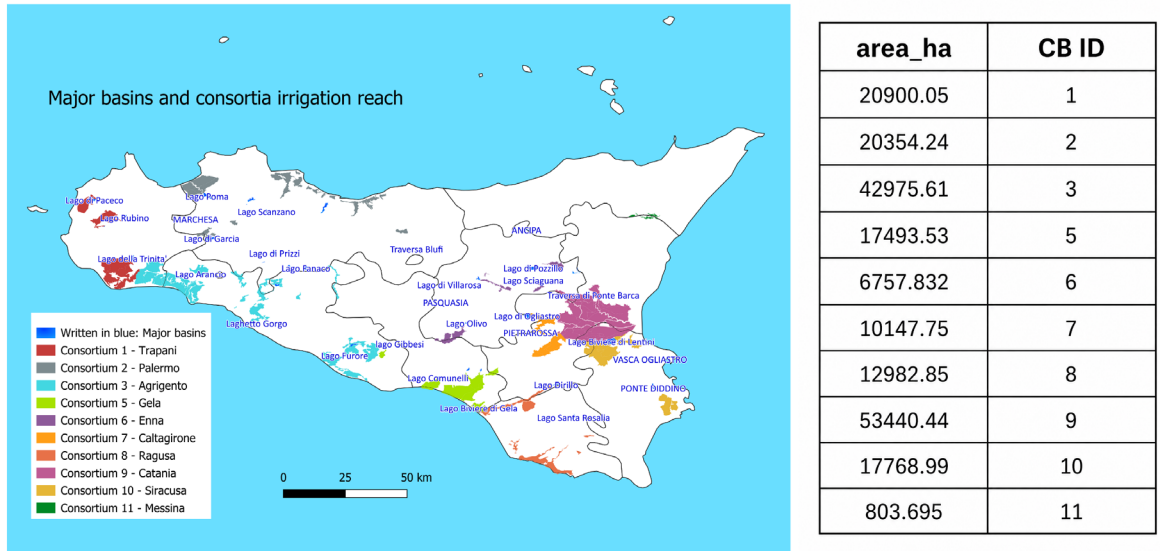


Figure 1: Major basins and consortia irrigation in Sicily, Italy. Source: Barbetti (2025), based on data shared by Mario Alerci from the Reclamation Consortium 6 Enna.

The hydrological benefits of artificial basins are clear. They replenish groundwater, improve water flow, and stabilise water supply, buffering against precipitation fluctuations and drought. However, they are costly to maintain, and their contribution to agricultural resilience remains understudied.

Drawing on research in Sicily, Italy, this policy brief presents evidence of the impact of artificial basins on agricultural productivity, vegetation health, and agricultural resilience in the region, using administrative and remote sensing data.

Figure 2 shows the location of the 11 irrigation consortia in Sicily. We compare the average agricultural and ecological outcomes of these irrigation zones with the 5-km buffer rings around the irrigated areas (i.e. control zones).

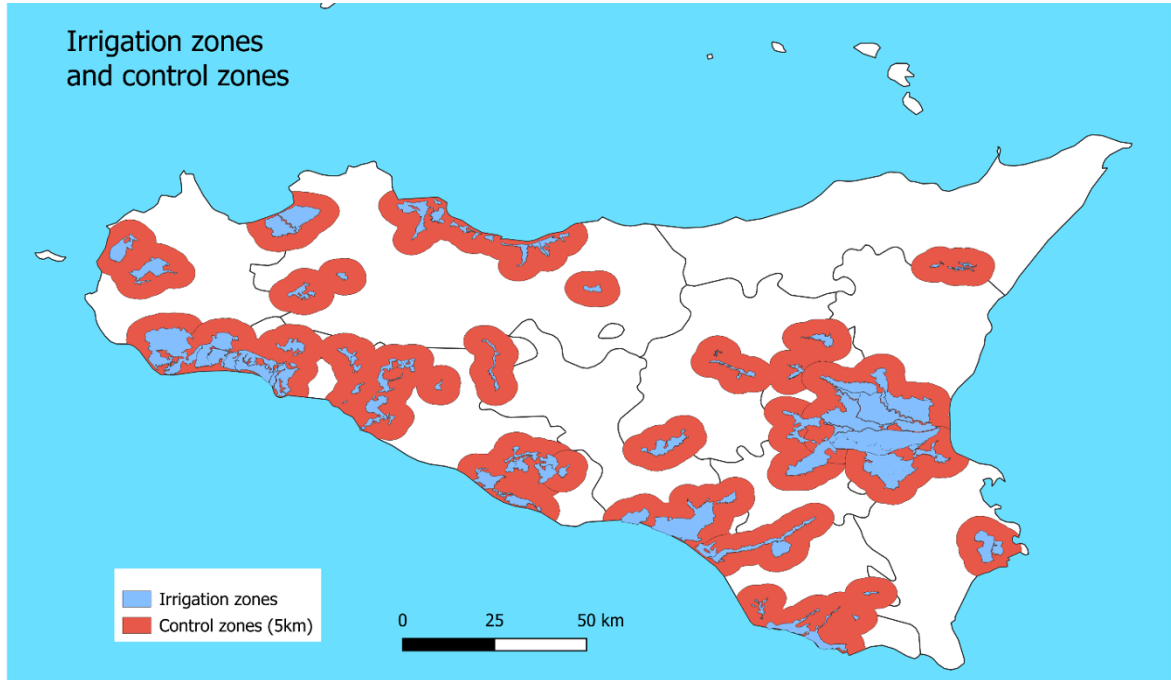


Figure 2: Irrigation and control zones. Source: Barbetti (2025).

Artificial basins raise agricultural production

We compare the average yields of six agricultural products in the irrigation and control zones between 2006 and 2024. The geographical distribution of the crops is displayed in Figure 3.

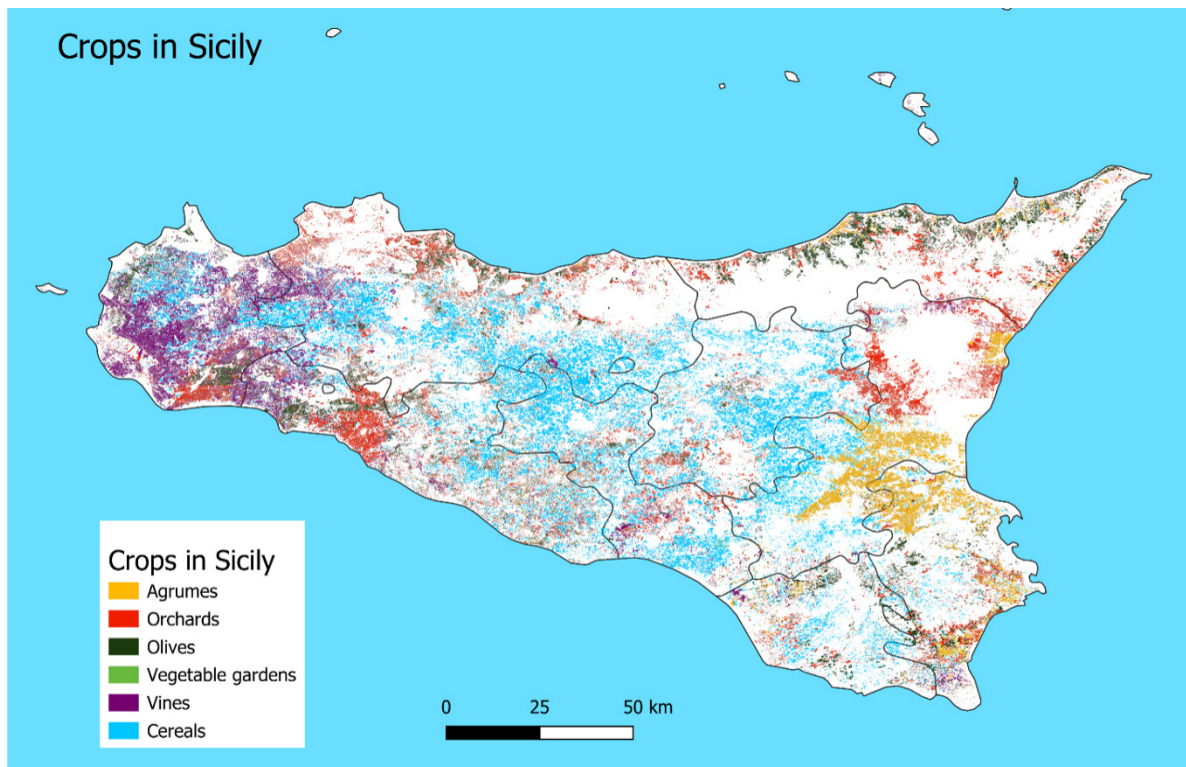


Figure 3: Crops in Sicily. Source: Barbetti (2025).

Results from our statistical models show that coverage of artificial basins is associated with higher production levels, but not all types of crops benefit from it. Each additional percentage point of artificial basin coverage in irrigation zones corresponds to a 7.4-percentage-point rise in citrus orchards (agrumeto) production in a given year. It is 4.8 percentage points for olive groves (oliveto) and 2.0 percentage points for vegetables and nursery crops (orto / vivaio). However, there is no statistically significant association with winter cereals (cereali invernali), fruit orchards (frutteto), and vineyards (vigneto). The variations could be related to the unequal distribution of rainfall in Sicily, crop water tolerance, basin management practices, and the availability of financial resources.

The agronomic benefits vary by area as well. Table 1 reports our findings by province. Results show that artificial basins benefit Caltanissetta the most. Each additional percentage point of artificial basin coverage in irrigation zones in the province corresponds to a 9.87-percentage-point rise in average production in a given year. The benefits are modest, ranging from 2.5 to 4.5 percentage points in Agrigento, Catania, Enna, Ragusa, and Siracusa. There is no statistically significant association between coverage and production in the other provinces, possibly due to the size of basins, the irrigation networks, maintenance, water loss in distribution, and fragmented governance structures.

Table 1: Production increase by province

| Province | Benefit (percentage point) |
|---------------|----------------------------|
| Agrigento | 4.49 |
| Caltanissetta | 9.87 |
| Catania | 2.60 |
| Enna | 2.45 |
| Messina | No association |
| Palermo | No association |
| Ragusa | 3.73 |
| Siracusa | 4.32 |
| Trapani | No association |

Crops are healthier in irrigation zones

We use Normalised Difference Vegetation Index (NDVI), which measures vegetation greenness, and the Vegetation Health Index (VHI), which measures vegetation stress, as a proxy for vegetation health. On average, NDVI index in the irrigation zones is 0.03 units higher than in the control zones, while the VHI index in the irrigation zones is 1.13 units higher. The estimated effects are statistically significant, indicating that crops in the irrigation zones are healthier than those in the control zones.

Uncertain effects of artificial basins on agricultural resilience

We also examine whether soil moisture and evapotranspiration are different in the irrigation and control zones. The included indicators measure root-zone soil moisture, surface moisture, infiltration and runoff dynamics, latent heat flux, and the leaf area index. Across all indicators, we find no statistical differences between the two zones. Even where irrigation is present, water uptake during dry seasons may be quickly offset by evapotranspiration and persistent infrastructure issues. While irrigation helps with vegetation productivity, its role in altering the broader soil water balance remains uncertain.

Key points and recommendations

1. Increase investment in collecting, harmonising, and publicising detailed spatial and temporal data on irrigation systems. Official data on irrigation infrastructure, water distribution, and crop-level performance are fragmented and not publicly available. Data on artificial basin operation calendars, delivery volumes, and actual irrigated surfaces, disaggregated by crop type and province would be helpful in research on drought risk management. These datasets should be digitised, regularly maintained, and made available through a centralised platform to support decisions.
2. Resolve operational bottlenecks in high performance territories. Field evidence and administrative records show that delays in maintenance, ageing pipelines, and partial system operation are common issues. Efforts should concentrate not only on extending coverage but also on improving the reliability and efficiency of water distribution systems. These include expanding storage capacity, replacing outdated pipelines, and repairing or reactivating malfunctioning infrastructure.
3. Conduct performance audits and requalification in underperforming areas. In provinces like Trapani and Palermo, where artificial basins are already widespread but show weak performance, further expansion may not be optimal. Chronic inefficiencies, ranging from water losses along the network to administrative disorganisation, could limit the benefits of existing infrastructure. Instead, a careful review of system performance should be undertaken to assess system performance and returns.
4. Align irrigation strategies with crop-specific requirements. Our results suggest that crops such as olives, citrus, and vegetables are highly responsive to basin expansion, whereas others may suffer from excess water or mismatched irrigation timing. These differences call for a more nuanced approach to irrigation planning that recognises the diverse water needs and growth cycles of specific crops. Future strategies should incorporate crop calendars, use adaptive irrigation systems, and avoid blanket designs.
5. Devise a comprehensive resilience strategy. Irrigation infrastructure should be considered only one part of a broader drought resilience strategy. Additional storage capacity (e.g. auxiliary basins), improved coordination of water deliveries, and the integration of drought forecasting systems capable of triggering timely responses by local consortia are all additional measures that can strengthen the agricultural resilience of the region.

Expanding irrigation infrastructure alone is unlikely to strengthen drought resilience without improvements in governance, data transparency, and system operation.

Acknowledgements

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