



Water Availability and Security
in Southern Europe and the
Mediterranean
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Climate change impacts and adaptation in Syros Island, Greece



Overview of climate-related challenges in Syros Island, Greece

In brief:

- Climate projections for Syros (A1B SRES) indicate an increase in temperature and a decrease in precipitation
- Direct climate change impacts could be positive for tourism (development potential through the prolongation of the tourism season) and negative for agriculture, due to increased irrigation needs
- Water balance modelling results suggest a deterioration in terms of water scarcity, mainly affecting agriculture but also the domestic sector
- Water security threats in Syros cannot be alleviated without further investing in water supply technologies; rainwater harvesting can improve reliability in water supply provision and resilience to extreme events, and should be considered as supplementary solution

The island of Syros is part of the Cyclades complex in the Southern Aegean Sea. It has an area of 84km² and a total population of about 22,000 inhabitants. The capital of the island, Hermoupolis, is the administrative centre of the Region of South Aegean, which includes the Cyclades and the Dodecanese island complexes. Currently, the economy of Syros is based on the operation of the Neorion shipyard, agriculture (mainly greenhouse cultivations), livestock breeding, services and tourism.

Syros is semi-arid, with dry summers and yearly average precipitation of 400 mm/yr, 84% of which occurs between October and March. In response to increasing water scarcity, the island has turned to seawater desalination to satisfy domestic water demand. The traditional practice of rainwater harvesting through cisterns is still practiced by the local population; however, cisterns are not mandatory in new developments, gradually increasing the need for new investments in the public water supply system. Rainwater harvesting is also practiced in agriculture, where the main water supply source is groundwater. Over the years, aquifers



The Syros greenhouses



Desalination in Syros

have been intensively exploited, resulting in water quality deterioration.

Climate change may exacerbate current problems, contributing to the following issues:

- Further limitations in freshwater availability resulting to the intensification of water scarcity problems, particularly for agriculture;
- Increased infrastructure requirements and costs to accommodate alternative tourism patterns, as well as changes in income distribution from tourism and agriculture;
- Increased overexploitation of groundwater resources, in order to meet water requirements for the different sectors.

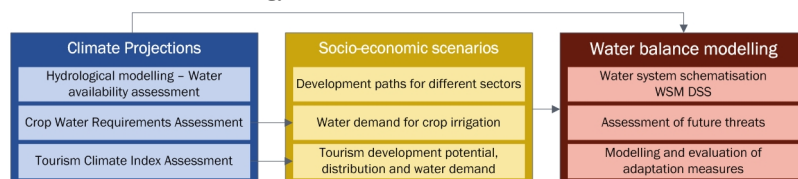
Employed methods

For the purpose of gaining a better understanding of potential climate change impacts, the WASSERMed Case Study for Syros focused on assessing direct impacts for tourism and agriculture, as well as indirect effects, based on water balance modelling.

Climate change impacts on tourism were examined based on the Tourism Climate Index-TCI (see Factsheet 4). Impacts on agriculture were assessed by estimating changes in Crop Water Requirements - CWR. Water balance modelling was based on the WaterStrategyMan DSS

(see Factsheet 7). Simulations involved combinations of climate change and socio-economic development scenarios. These concerned alternative development paths for the tourism and agricultural sectors (unilateral or balanced sectoral development) and integration of environmental conservation measures.

For all these scenarios, adaptation measures were modelled and assessed in terms of effectiveness, costs and benefits, and further discussed with local decision-makers and stakeholders.

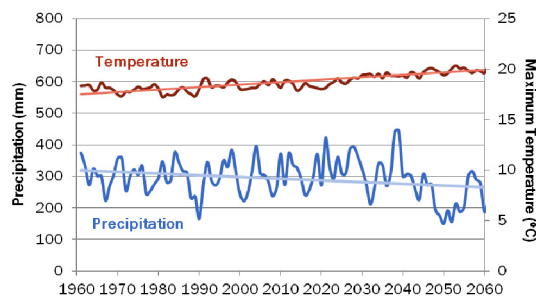


Integrated assessment of climate change impacts and adaptation options in the Syros Case Study

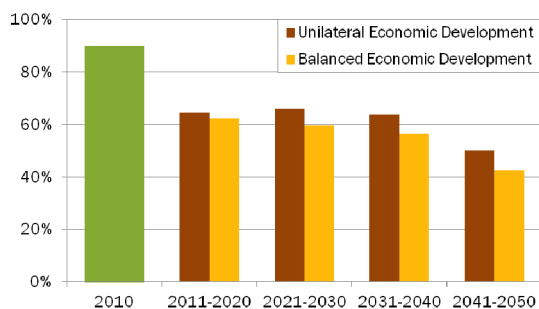
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Main results

- Climate projections (HIRHAM5 RCM driven by the ECHAM5 and HadCM3 GCMs, A1B SRES) indicate an increase in maximum temperature of about 1.5°C and a decrease of annual precipitation of 30 mm by 2050.
- Climate change could have positive effects for tourism, particularly after 2030. An increase potential of about 10% for arrivals and overnight stays is estimated for 2051-2060 vs. the 1981-2010 period. This corresponds to a possible prolongation of the tourist season towards spring and autumn, and to a minor decrease of tourism flows during summer.
- The Net Irrigation Requirements for all major crop types would gradually increase due to climate change, resulting in higher water demands in the agricultural sector.
- Under all socio-economic scenarios and with no further integration of measures, water balance modelling results suggest that water security could gradually deteriorate in the future, for both the domestic and the agricultural sectors. From 2030 onwards, the domestic water deficit could be more pronounced, whereas the situation is worse for the agricultural sector. This refers to both the average coverage and to the reliability in meeting sectoral water requirements.
- Results from the simulation of five adaptation measures, suggested by local stakeholders, show that water security threats cannot be alleviated without further investing in water supply technologies. Softer, low-cost interventions, such as cisterns, can improve reliability in water supply provision and resilience to extreme events, and should be considered as supplementary solutions.



Trends in yearly precipitation and maximum temperature in Syros [HIRHAM5 RCM driven by the ECHAM5 and HadCM3 GCMs, A1B SRES]



Estimated average decadal water deficits in the agricultural sector for a unilateral and a balanced socio-economic scenario, incorporating climate change impacts

Performance and economic assessment of adaptation measures.

Ranges refer to average values for 2020-2050 for different combinations of socio-economic scenarios and climate projections

Measure	Average coverage of irrigation demands	Reliability in domestic demand coverage [95% threshold]	Economic benefit-cost ratio
None [scenarios with no measures]	60-67%	78-81%	-
Rainwater harvesting—Agriculture	65-72%	81-84%	0.01-0.11
Rainwater harvesting—Domestic Use	57-67%	80-82%	1.31-3.35
Desalination capacity expansion	61-71%	84-95%	0.32-4.10
Wastewater reuse	72-77%	87-92%	2.00-2.32
Artificial aquifer recharge	69-74%	81-85%	0.98-1.12

Recommendations

- Climate change could have a positive effect on tourism, as the suitability of Syros as a summer tourist destination would not be significantly affected, and climate conditions could favour a prolongation of the tourist season towards spring and autumn. The realisation of this development potential would require additional investments in infrastructure and the enhancement of the offered tourism services.
- The agricultural sector would be negatively impacted; sustaining agricultural activities can only be possible through water supply augmentation measures, as demand management interventions have already been implemented to a significant extent.
- The further integration of non-conventional supply, and particularly water reuse, emerges as the most promising adaptation measure, as it would alleviate water scarcity in agriculture and improve resilience against future droughts.
- There is need for stronger collaboration among decision-makers and water users, particularly in the agricultural sector. The fostering of traditional water management practices and the re-integration of the agricultural sector in development plans would require coordination among authorities, and the representation of water users in relevant processes.