Water Availability and Security in Southern EuRope and the Mediterranean
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Factsheet No 9

Climate change impacts and development perspectives in Sardinia, Italy

Sardinia: Overview and climate-related challenges

In brief:

- *Future water-related security threats in Sardinia were analysed in an integrated way, combining climate change projections, strategies for agricultural expansion and tourism development scenarios*
- *Estimates indicate slight changes in crop water requirements between 2005 and 2050, and positive impacts for tourism*
- *Results depict that the current storage capacity is adequate to meet water demand up to 2050*
- *Local and temporal shortages may increase due to limitations in network capacity, and further investments may be required*

Sardinia is located at the centre of the Mediterranean Sea. It has an area of 24,090 km², subdivided into plains (14%), hills (68%) and mountains (18%). The total resident population is 1.6 million, with 34% concentrated in Cagliari, the capital. The climate is typical Mediterranean, with an annual precipitation of 600 ± 400 mm/yr, mostly concentrated between October and March.

The economy is structured in different sectors, with tourism accounting for about 27% of Gross Domestic Product (GDP) and agriculture for 4%. Water requirements mainly rely on the numerous storage reservoirs, although some areas rely on spring water or groundwater.

Agricultural land accounts for about 47% of the total area of the island, but only 7% of this area is currently irrigated, using about 270 million m³/yr of water. Tourist flows (38 million overnight stays were estimated in 2007) correspond to annual water demands of about 9 million m³, with marked seasonal peaks in coastal areas. Competition for water is likely to increase as the two sectors expand.

Climate change scenarios forecast minor changes in water availability in Sardinia by 2050, while precipitations decrease in the following half century. The development of the tourism and agricultural sectors under climate change scenarios pose two threats related to water security: (a) reduced water availability for irrigation and urban use, and (b) environmental degradation, due to the high concentration of economic activities along the coast.

Employed methods

Water demand projections for 2050 were calculated through water balance models, accounting for climate projections and different development scenarios for the tourism and agricultural sectors.

Climate change in Sardinia was represented by the RegCM3 regional climate model results (GCM ECHAM5-r3; 25 km resolution; A1B SRES) available through the Ensembles RT3 validation assessment. Irrigation requirements were estimated by soil water budget and crop evapotranspiration models (SIMETAW), driven by present (2005-2010) and future climate projections (2045-2050).

Four different scenarios were used to evaluate the viability of policies for irrigation expansion. Business-As-Usual (BAU) refers to a 20% expansion of irrigated areas (15,000 ha) for dominant irrigated crops (IWS), for selected water efficient crops (ISC) over the entire island, or for dominant irrigated crops in the central plains (ICP).

Climate change effects on tourism were assessed using the Tourism Climate Index (TCI). TCI values were calibrated using tourist flows for the period 1997-2007, and projected for 2050. Water demands were estimated to accommodate four different development scenarios for the tourism sector: Business-As-Usual, Intensive Tourism Growth (ITG), Strictly Controlled Sustainable Tourism (SCST) and Balanced Competitive & Sustainable Growth (BCSG). Results were analysed to highlight potential conflicts and to help optimise development policies.

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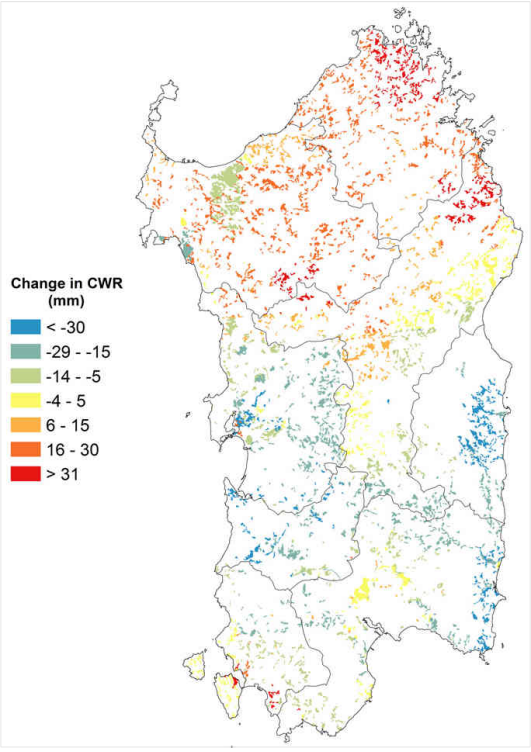
Main results

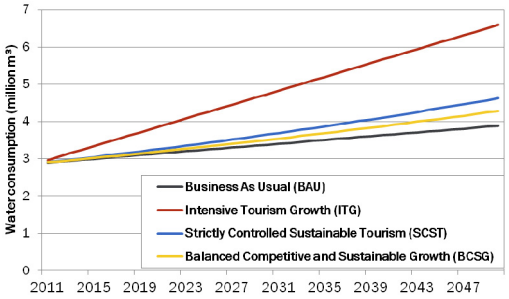
Projected climate trends forecast a slight positive increase in both mean annual temperature and precipitation (especially in summer) between 2005 and 2050. This is equivalent to sufficient rainfall to satisfy increasing vegetation water demand (ETo) in the agricultural sector. Although a conspicuous increase in irrigation needs (17%) is estimated between the baseline period (1960-1990) and 2005, the change in crop irrigation needs is negligible between 2005 and 2050. Spatially, irrigation needs show significant decreases in the large central plains, while increases are expected in the north-eastern part. The water requirements needed to expand irrigated areas by 15,000 ha correspond to (a) 50.8 million m³/yr, if applied across Sardinia only for irrigation efficient crops (ISC scenario), (b) 56.8 million m³/yr, if applied to dominant crops only across regions with limited climate change impact on irrigation requirements (ICP scenario), and (c) 59 million m³ /yr, if applied consistently across Sardinia to dominant crops (IWS scenario).

Total irrigation needs under historical and present conditions and for future scenarios

Period	Development Scenario	Total Irrigation Needs (million m³/yr)
1960-1990	-	259.2
2005-2010	-	303.1
2050	BAU	294.6
	IWS	353.6
	ISC	345.4
	ICP	351.4



Changes in Crop Water Requirements (CWR) for irrigation needs between 2010 and 2050



Evolution paths for water demand levels relating to tourism flows per scenario (2011-2050)

Per capita (tourist) water consumption (236 l/d on average) and regional projections of future overnight stays (predicted only on the basis of climate change-related effects) have been used to assess future trends of water demand for tourism in Sardinia. By assessing the direct impact of long-term climatic changes on tourist preferences and flows, TCI projections overall predict an enhanced tourist attractiveness and a positive trend of related overnight stays, The cumulative increase by 2050 is about 13%, mostly concentrated in shoulder and low seasons. The SCST and even more the BCSG scenarios are the ones that could better take advantage of this positive effect of climate change.

Current storage capacity is sufficient to satisfy the increase in water demands under all the combinations of development scenarios that have been considered. However, for some areas the network is inadequate to sustain peak demands; thus, local and temporal water shortages are likely to become more pronounced. Additionally, climate projections after 2050 indicate a decrease in rainfall, consequently bringing about higher irrigation needs and a decline in water storage.

Recommendations

- All development scenarios will require investments to implement and optimise water distribution networks. Among the possible tourist development, the SCST and the BCSG are suggested as they require smaller investments, and cause lower environmental impacts. Furthermore, the distribution network for these two scenarios partially overlaps with the present network and that necessary for agricultural development.
- Climate change scenario suggest that water requirements for irrigation will increase rapidly between 2050 and 2100.