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The Water-Land-Energy-Food-Climate Nexus In Sardinia

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Water use in the Mediterranean has been often pushed beyond sustainability, leading to water degradation and deterioration of ecosystem services. Different factors are interlinked with water management within a dynamically complex system (i.e. the Nexus) characterized by many feedbacks, trade-offs and high complexity of socioeconomic and environmental agents inducing non-linear responses hard to predict. Understanding such nexus systems requires innovative methodologies able to integrate different domains (e.g. hydrology, economics, planning, environmental and social sciences) and potential feedbacks, to support effective and targeted adaptation measures, taking into consideration uncertainty of climate change forecasts and associated impacts. Within the H2020 SIM4NEXUS project, water-land-energy-food-climate nexus links for Sardinia Island were represented with system dynamics modelling, together with relevant policy objectives, goals and measures. Sardinia, as many other Mediterranean regions, must implement a sustainable approach to water management, taking into account an equitable distribution of water resources between different sectors, economic needs, social priorities and ecology of freshwater ecosystems.

For the Sardinia case study, the main focus was the representation of the reservoir water balance for the island, accounting predominantly for water supply and for water demand related to agricultural, hydro-power production, domestic/tourist consumption and environmental flows. With irrigated agriculture being the largest water consumer, this sector was modelled in more detail with crop specific distribution and projections. While water is the central focus, links with other nexus sectors including energy, climate, food and land use are included. Energy generation and consumption were also important along with the mode of generation and sector of consumption, as was modelling the change in crop types (i.e. land use and food production changes) and the crop water requirements associated with potential crop and cropped area changes, and in response to change in the local climate. Energy production is modelled from sources including oil, coal and methane, solar, wind and hydropower, while energy demand comes from the agricultural, domestic, industrial and service sectors (including transportation). The use of energy from the different sectors and using different energy sources, either renewable and not renewable, have different implication on GHG and climate change.

While driven by strong interests to secure food provisions, an increase in irrigation in the Mediterranean may not be totally sustainable. Irrigation requirements of crops are projected to

increase between 4 and 18% for 2050 compared to present conditions, limiting expansion of irrigated agriculture in Sardinia. Over the same period the inflow in the reservoirs can decrease between 5 and 20% and evaporation losses from reservoir surface bodies increase by 10%. Policy rules are tested and highlight how optimal allocation should be enforced in order to safeguard sustainability of natural resources over time, especially when considering climate variability. Natural resources are better preserved avoiding conflicts with strong seasonal peaks (i.e. summer). To meet these criticalities, new infrastructures and investments should increase use efficiency, All this would require changes in institutional and market conditions with a more cautious water management that includes prices and recycling policies.