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## The AWESOME Project: A decision analytic framework for managing Water Energy Food and Ecosystems across sectors and scales in the South Mediterranean

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Rapid population growth and rising economic prosperity are imperatively challenging the South Mediterranean and the African North-East to a point where they may compromise the sustainable use of natural resources. In those regions, the demand for water, energy, food, and the preservation of ecosystems are expected to increase relevantly. Transboundary rivers like the Nile River Basin represent an enormous source of water, energy, food, and ecosystems (WEFE), which often brings conflicts and individualistic policies among the sharing countries. The adoption of integrated and participatory approaches that explicitly account for the WEFE Nexus are necessary to explore multisectoral synergies and tradeoffs and to generate shared economic, environmental, and societal benefits.

Focused on the Nile River Basin and born in this context, we present here the AWESOME project (i.e. mAnaging Water, Ecosystems and food across sectors and Scales in the sOuth Mediterranean), whose main objective is developing a decision-analytic framework based on a multi-level, integrated WEFE model to address the Nexus and explore the interdependencies and feedbacks across a hierarchy of spatial scales, from the macroeconomic development (macro), to regional planning (meso), down to the single farm (local).

At the local scale, a demo-site of smart agricultural solutions (soilless agriculture, e.g., hydroponics, aquaponics) is currently under construction, and it will provide indicators on effectiveness and

sustainability of these new technologies to back up existing systems in a dryer future. The study on site will also demonstrate the performance of such a technology within its local economy and ecosystem. At the meso scale, we are developing a decision-analytic framework covering the course of the Nile River Basin, from the Grand Renaissance Dam (GERD) in Ethiopia up to the Nile Delta, based on hydrological models and combined with the results of systems analysis methods with advanced a-posteriori multi-objective optimization algorithms. We plan to simulate existing water availability, water distributions system and new agricultural technologies, upscaling the local scale assessments while downscaling the climate, energy, crop, and ecosystems projections at the macro scale. This approach allows the design of a set of efficient solutions and associated performance with respect to the WEFE multidimensional assessment space, where stakeholders and policy makers will be able to explore multisectoral tradeoffs and negotiate potential compromise alternatives.

We expect that AWESOME will make substantial progress in complex systems analysis to support the transition towards a more sustainable and resilient agriculture along the Nile River Basin under diverging water availability and demand due to the projected impacts of changing climate and society.