Decision support-based approach for sustainable water reuse application in agricultural production

http://dswap-prima.eu/ https://twitter.com/DSWAP1

The Problem

Wastewater treatment requirements for effluents used for agricultural irrigation are considerably different from those of effluents discharged to aquatic environments. For example, nitrogen and phosphorus are essential elements for plant cultivation and therefore exhaustive processes for reducing nutrients (i.e. denitrification and phosphate removal) are not imperative in wastewater reuse for irrigation. Conversely, the capacity of human pathogens and antibiotic resistance genes (ARGs) to persist on and potentially colonize plant tissues, as well as evidence of the uptake of various contaminants of emerging concern (CECs) by crops makes treated wastewater irrigation a potential public health hazard because these elements can be transferred to humans and animals through the food chain. In addition, the detrimental long-term effects of effluent-derived salinity and CECs on soil structure and crop yield in treated wastewater irrigated fields (especially in clay-rich soils) suggest that salt removal may be crucial when irrigating with wastewater effluents. Also, classical wastewater treatment practices need to be revisited in the context of wastewater reuse so as to consider different effluent quality obligations.

DSWAP Concept

DSWAP adopts a circular economy approach, aiming for safe and sustainable valorization of wastewater for irrigation, with minimized ecological and agronomic impacts. The overall concept is to develop cost-effective, modular, de-centralized wastewater treatment/irrigation systems coupled to a decision support tool that enables the removal of unwanted parameters such as pathogens, CEC's, and salinity, while retaining wanted/beneficial parameters such as nutrients—the levels of which can be adjusted depending on the need. This will be achieved by the coupling/decoupling of treatment modules as a function of the wastewater source and measured quality parameters, and will ensure optimal reused water quality for irrigation and long-term sustainability of irrigated soils. Individual modules within these networks will be coupled to alternative energy sources to reduce costs and greenhouse gas emissions.

The above concept will focus on **seven wastewater treatment modules:** (a) **two novel decentralized secondary treatment modules**, (b) **three energy-efficient advanced treatment modules specifically designed to remove microbial and chemical contaminants** and (c) **two units designed to remove salinity**. A key component of the DSWAP project is the decision support tools for the application of post-treatment desalination and pathogen intervention, which requires efficient data transfer, processing and harmonization from online and offline monitoring sources. The monitoring will rely on a comprehensive diagnostic toolbox, which will not only evaluate the quality of the effluents from individual and integrated modules, but also their impact on soil quality, ecosystem functioning and agronomic performance.

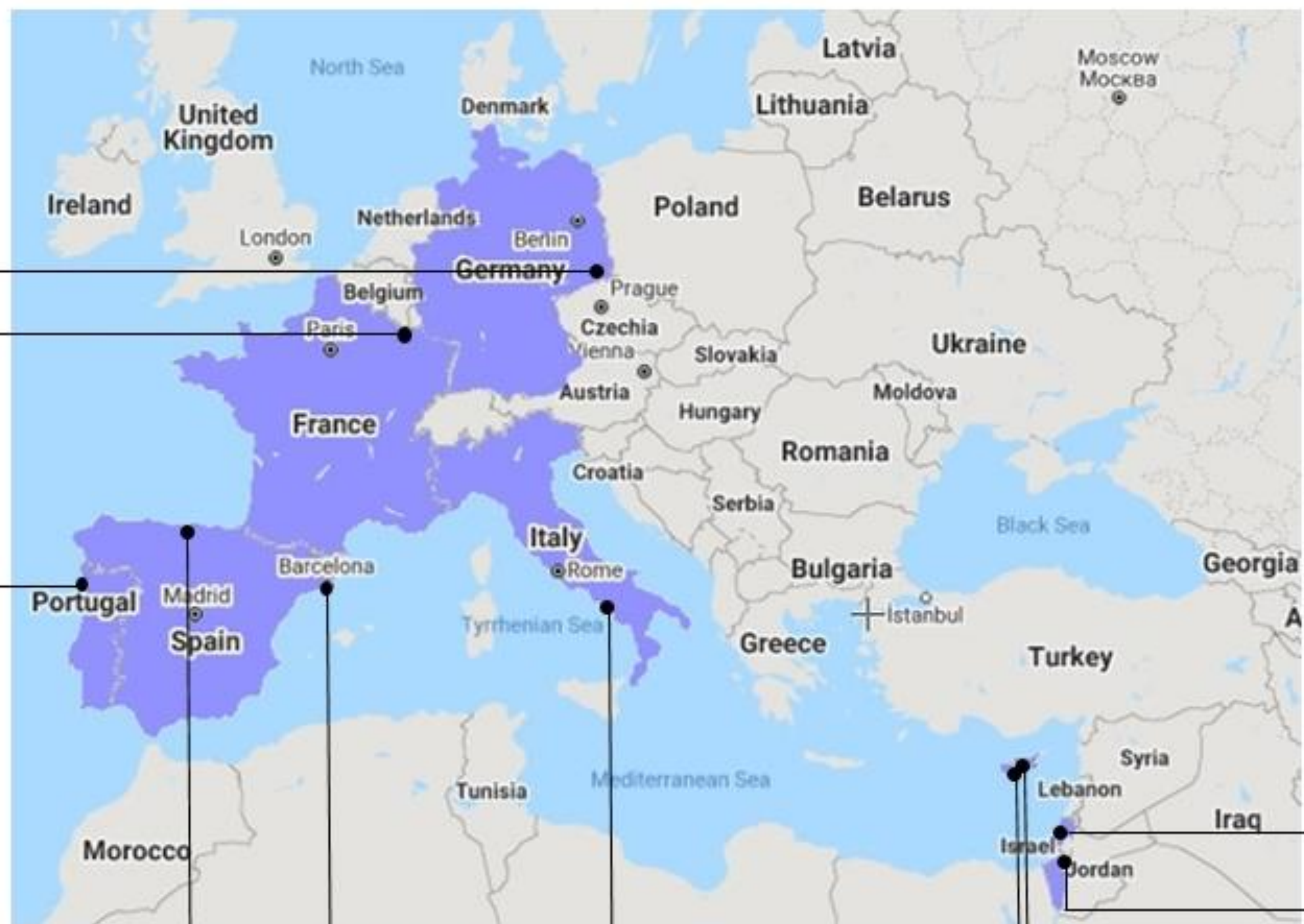
Objectives

The main goal of DSWAP is to develop modular cost- and energy-efficient wastewater treatment systems specifically designed for wastewater reuse in the context of crops irrigation that safeguard public health, environmental and soil quality and long-term agronomic sustainability.

Optimization and evaluation of energy-efficient secondary treatment modules specifically designed for integration to decentralized wastewater reuse systems.	Development and evaluation of novel advanced treatment modules for integration into decentralized wastewater reuse systems for reduction of microbial pathogens, MGEs, ARGs and CECs.	Development and evaluation of modules for reduction of effluent salinity to prevent soil salinization, which under certain conditions cause deterioration of soil quality and crop decline overtime.	Evaluation of the individual performances of different integrated modular configurations that meet the needs and criteria of specific stakeholders based on local infrastructure, geography, influent load, installation and energy costs and maintenance availability.	Development and application of decision support tools that integrate and evaluate data generated by a myriad of state-of-the-art diagnostic tools for holistic evaluation of microbial, chemical, phyto-toxicological and ecosystem functioning-associated parameters in effluents and in corresponding irrigated soils.

Abbreviations:
CECs: Contaminants of Emerging Concern
ARGs: Antibiotic Resistance Genes
MGEs: Mobile Genetic Elements

DSWAP Consortium



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Work Packages

- **WP1** Module optimization and implementation
- **WP2** Diagnostic toolbox
- **WP3** Decision support tool
- **WP4** Communication/Dissemination and Training
- **WP5** Project management

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