Decentralised alternative water sources, closed water loops and nature-based solutions: legislative and institutional analyses

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Abstract: This prospective study was critically assessed the EU directives, regulations and standards to reveal the barriers, pros and cons for integration of nature-based solutions within the concept of closed water loops approach developed by HYDROUSA project. The project aim to solve issues related to the water supply, the wastewater problem, the biodiversity and nutrient loss, by means of the implementation of six innovative technology solutions. In this work, proposed technologies were assessed to evaluate how their implementation is supported by the European Legislative Framework and if constrains or obstacles are detected for the replicability of the tecnologies. Main results of the Legislative analysis highlighted that no relevant barriers prevent the implementation of the HYDROUSA technologies in the European context and thus the replicability can be studied at further national level.

Keywords: Decentralized systems; Nature-based solutions; Circular cities

The concept of resourceful circular cities is built on a sustainable management approach including water-energy-food nexus, effective land usage and diversification of water resources due to the pressure on water supply systems resulted by climate change, urbanization and population growth (Kalantari et al. 2018; Yan et al. 2018) and many countries are integrating nature based alternative water technologies to diversify water resources to solve water supply issues (Mankad and Tapsuwan 2011). Decentralized water systems are sustainable, resilient systems in which uses alternative water sources (gray water, stormwater, water vapour etc.), fit-for-purpose water supplies and enable to closed water loops. They can be applied at local scale to manage urban water issues (Leigh and Lee 2019). Horizon2020 project HYDROUSA, aims to provide innovative compact solutions for water/wastewater management in Mediterranean regions (https://www.hydrousa.org/). In the project, 6 technologies (HYDRO) were developed to revolutionize the water supply chain, involving different water categories (Figure 1.1). Whereas, a sewage treatment system in HYDRO1 will be operated to produce water for fertigation and compost for agroforestry system installed in HYDRO2, biogas will be recovered as renewable energy source. In HYDRO3 and HYDRO4 rainwater recovery systems will be installed. Whereas, in HYDRO5 seawater will be desalinized to produce water for fertigation, water vapour system will be operated in HYDRO6.

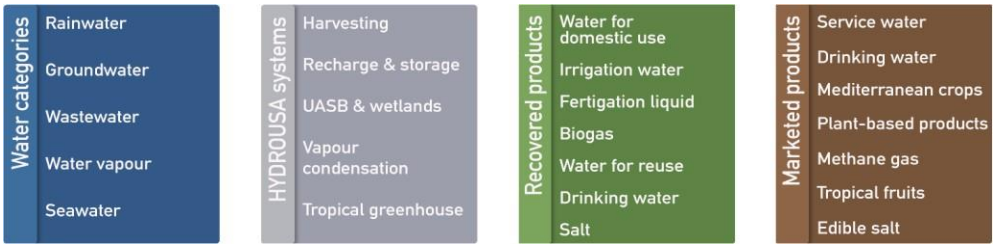

Figure 1.1 HYDROUSA's Approach with Innovative Regenerative Technologies (https://www.hydrousa.org/)

In this study, it was aimed to review the EU legislations, regulations and standards to determine the barriers for integration of nature-based solutions within the concept of closed water loops

approach developed by HYDROUSA project. The legislative analysis will reveal a framework to support decisions for the best and safe exploitation of the HYDROUSA solutions for decentralized environments.
All the HYDROs were assessed in the context of: The Water Framework Directive and its daughter Directives; the Urban Waste Water Treatment Directive; the Sewage Sludge Directive; the Fertilizer Regulation and the Food safety legislation; ISO and EN technical standards. Further, Hydro technologies implementation was evaluated in the context of main European initiatives (i.e. policies on phosphorus; resource-efficient initiative; EU biodiversity strategy; EU climate change adaptation and disaster prevention; Thematic Strategy for Soil Protection; EC Innovation Deal for reuse of the final effluent from wastewater treatment). Table 1.1. presents the overall regulatory framework and possible barriers/constrains in relation with specific HYDROs.

Table 1.1 Results of the Legislative analysis in the context of the HYDROUSA Technologies implementation

Directive legislation	HYDRO Involved	Possible barrier/constrains
Water Framework Directive	HYDRO 4 and 6	No relevant barrier identified
Groundwater Directive	HYDRO 4	No relevant barrier identified
Urban Waste Water Treatment Directive	HYDRO 1 and 6	No relevant barrier identified
Proposal for Regulation on Reclaimed Water Reuse	HYDRO 1 and 6	No barrier identified, when quality standards are achieved
Drinking Water Directive	HYDRO 4 and 6	No relevant barrier identified
Sewage Sludge Directive	HYDRO 1 and 6	No relevant barrier identified, but with limitations for food crops growing period
Fertilizer Regulation	HYDRO 1 and 6	Barrier found for marketing and labelled compost
Food Safety Legislation	HYDRO 2, 5 and 6	No relevant barrier identified
Organic Farming Regulation	HYDRO 1 and 6	Barrier found for organic food production
Regulation on Biogas and Biomethane	HYDRO 1	No relevant barrier identified
EC Policy on Phosphorus	HYDRO 1 and 6	No relevant barrier identified

From the analysis of the main European Directives and Regulations, no relevant barriers are identified for the replicability of the HYDRO in the European context. However, quality standards and monitoring activities, on the main chemical and physical parameters of the recovered products/water resources, are fundamental to reach the compliance for the reuse. In this perspective, standards represent the actual challenge to be tackled for the HYDRO solutions.

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