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WATER AND WASTEWATER MANAGEMENT IN THE CONTEXT OF CLIMATE ADAPTATION

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Introduction

Climate change is altering the temporal and spatial distribution of precipitations, evapotranspiration rates and rainwater infiltration into the soil thus compromising the hydrological cycle and reducing the availability of renewable water resources. The increase of extreme events like droughts and floods implies a growing pressure on water sector – affecting water quality, infrastructure, and service reliability – and impacts on other sectors, as for instance agriculture, energy production, and public health. Such pressure is further intensified by a combination of factors including competitive mechanisms in water demand (i.e. agriculture, civil uses, industry, energy production and tourism), which in turn are involved in dynamics such as population growth, urbanization and industrialization, as well as inefficiencies in the existing Integrated Water Service (IWS) infrastructure. Italy and Romania are facing growing water stress driven by climate change, increasing demand, and inefficient management, underscoring the urgent need for integrated and adaptive strategies to strengthen the resilience of the water sector.

Materials and methods

This short communication is based on data and reports provided by official international sources, i.e. the European Environment Agency (EEA), Eurostat, EurEau and national sources, with specific reference to renewable water resources, water consumption, leaks, wastewater treatment plants, and wastewater reuse.

Results and conclusions

Although the Water Exploitation Index (WEI+), a parameter defined to measure the pressure exerted on water resources, is currently low in terms of average value across Europe (5.76% in 2022), it is expected to significantly rise because of the increasing demand and climate-related impacts. However, significant regional variations already exist. Italy and Romania are among the countries with the highest WEI+ values in Europe in 2022, at 15.61% and 20.95% respectively. According to the EEA, a third of European countries have low availability of renewable water resources, including Italy and Romania, estimated at ~2,000 m³/y per capita. In addition to the overall availability of water resources (total amount of 134 and 40 billions of m³ per year for Italy and Romania, respectively), the local WEI+ index is influenced by agricultural water consumptions (15716 and 2184 million m³ per year in Italy and Romania, respectively), drinking water demand (~220 and 100 L/d per capita in Italy and Romania, respectively), together with water losses in public supply networks due to aging infrastructure (40% in both countries). Moreover, the

state of wastewater collection and treatment still presents significant critical issues. The sewerage system, which is usually a combined network in the two countries, is often inadequate to cope with intense rainfall events. In these cases, the activation of sewer overflow (SO) implies the uncontrolled discharge of raw wastewater into receiving waters causing environmental contamination. Moreover, wastewater treatment plants (WWTP) require a consistent upgrading to provide to higher incoming wastewater loads and to cope with new treatment challenges due to stricter quality standards, energy efficiency and circular economy. Both Italy and Romania are still not complying with European directive 91/271, since 11% and 60% of wastewater, respectively, is not adequately treated. Further, extreme climate events also threaten IWS infrastructure, disrupting water collection, rainwater drainage, sewer networks, and WWTP, with increased risks. The complexity of the current context highlights the need for climate adaptation strategies to preserve water resources by increasing system resilience. Priority actions include (i) Reduction of losses in water networks; (ii) Modernization of collection, treatment and distribution infrastructures; (iii) Modernization of sewage collection and WWTPs; (iv) Prevention of hydraulic risk, particularly in urban areas; (v) Promotion of Nature-Based Solutions (NBS)– i.e. detention areas and green infrastructures; (vi) Use of non-conventional water sources, including wastewater reuse, rainwater recovery and dissalation. In particular, the use of unconventional water sources, such as harvested rainwater and reclaimed wastewater, represents a key strategy to reduce pressure on primary water resources. Furthermore, irrigation with treated wastewater provides to crops nutrients, reducing the use of chemical fertilizers. However, the use of these solutions is still limited - only 2.4% of treated wastewater in Europe is directly reused. The new EU Regulation 2020/741 and the new EU Directive 2024/3019 overcome past regulatory constraints and promote water reuse in agriculture. In many countries, rainwater harvesting has been encouraging increasingly. Equally important is the active involvement of stakeholders and citizens which plays a crucial role in fostering responsible water use. Through awareness campaigns, it is possible to promote a strong culture of water efficiency and sustainability, encouraging collective action and long-term behavioral change.