PhD Thesis Defense

Doctor Europaeus Candidate

Liviana Sciuto (XXXVI cycle)

Will discuss her PhD theses titled

SUSTAINABLE USE OF WATER AND BIOMASS FROM WETLANDS IN THE INNER AREAS OF SICILY

On **Friday March 15th 2024 at 10.00am** at the classroom I, Via Santa Sofia 100.

Thesis Abstract

Under the current increasing water and energy demand scenario due to climate change phenomena, particular importance is reserved to all the systems and management strategies which allow to achieve good water quality and energy savings.

The general aim of this thesis is focused on the enhancement and sustainable use of wastewater (WW) and biomass from natural and treatment wetlands (TWs) for a better resources management. Specifically, this thesis would promote water and energy conservation strategies through (i) the treatment of WW from small and medium-sized civil and agro-industrial settlements, making use of natural treatment systems, to increase the availability of water resources in inner areas of Sicily; (ii) the possibility of using, for bioenergy production by anaerobic digestion, the biomass vegetation from both natural and TWs as energy crop, in order to mitigate the risk of streams flooding and to support the maintenance interventions costs; and (iii) the availability of remote sensed data free that, in combination with GIS tools, allow to monitor riparian ecosystem dynamics to mitigate the effects of natural hazards.

In particular, a GIS-based methodology for the identification of giant reed (GR) spatial distribution was implemented, allowing to map GR with an acceptable accuracy value and to quantify its availability in the Calatino area (South-East Sicily, Italy) for biogas and biomethane productions.

A Biochemical Methane Potential (BMP) testing approach was used to evaluate the GR aerial biomass potential for biogas production at different harvest times, showing that the retrieval of riparian vegetation for energy purpose represents a sustainable way to recover management costs and to reduce some environmental impacts.

Furthermore, the possibility to integrate the bioenergy production into TWs and the horizontal subsurface treatment wetland (HSTW) hydraulic conductivity of the substrate influence on the biomethane yield were investigated. The results showed the successfully possibility

of integrating the potential removal role of common reed (CR) vegetation with the bioenergy production into TWs, due to CR has shown the potential to act as an energy crop to produce satisfactory methane yield. Also, HSTW hydraulic conductivity appeared to influence the methane yield by plant growth.

In addition, the new century's challenges as global warming and climate change have pushed several authors to study TWs also in terms of environmental sustainability. The effects of solids accumulation on GHG emissions, substrate, plant growth and performance of a Mediterranean HF-TW planted with Phragmites australis were evaluated. Pore clogging appeared to affect carbon dioxide (CO2) emissions, which decreased from the inlet to the outlet.

Finally, an analytical method (i.e. P-k-C model) was calibrated and validated, in order to model the TWs treatment response, simulating, among others, NO3-, COD and microbiological removal through the assessment of the TWs key design parameters. The performance of the model in COD, BOD5 and NO3- simulation at the outlet of all TWs was very good in most of the cases, as also evaluated in terms of R2, NSE and RMSE.*

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